भाकृ अनुप
ICAR

CMFRI

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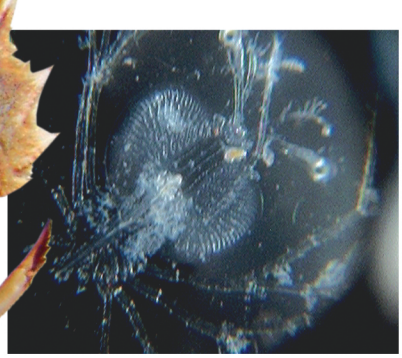
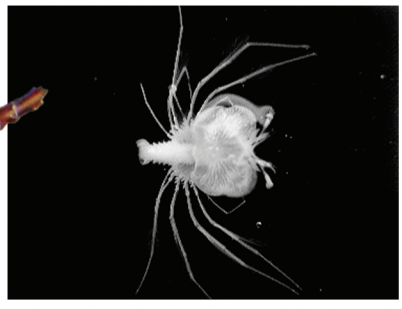
Annual Report
2003-04





Annual Report

2003-2004

भाकृअनुप
ICAR

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
Indian Council of Agricultural Research
Post Box No. 1603, Ernakulam North P.O., Cochin - 682 018, India

CMFRI Annual Report 2003-2004

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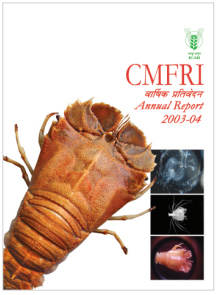

Images of adult and larval stages of slipper lobster, *Thenus orientalis*. India is the second country in the world to achieve captive breeding and larval rearing of this economically important lobster.

Scanning electron micrograph of a tissue cultured pearl from Indian pearl oyster *Pinctada fucata*. This breakthrough is a global first, achieved by the scientists of CMFRI.

Cover photo : Dr. E.V. Radhakrishnan; *Cover design & Layout :* Dr. K.S. Mohamed and Dr. P. Jayasankar

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CONTENTS

Preface

The marine living resources are dynamic and renewable and hence regular assessment and monitoring on their resource size, dynamics, exploitation rates and replenishment capacities is essential. The major mandate of CMFRI is to monitor and assess the exploited marine fishery resource and offer research outputs for formulating appropriate policy decisions for their management.

During the year under review, the scientists of the Institute have approached the issue of management of marine fishery resources through predictive and ecosystem modeling in addition to the regular data acquisition. The newly developed trophic model of the Arabian Sea off Karnataka is able to predict changes in yield and biomass of important resources with change in effort. The estimated total potential yield was 3.16 million t while the actual yield during the year was 2.66 million t. The useful information generated on exploitation rates of several important groups of fish and shellfish should help in reorienting the current fishing strategy with reference to the exploitation levels. The Ministry of Commerce and Industry, Government of India implemented the recommendation of the Institute on fixing Minimum Legal size for export of lobsters through a notification.

The ongoing monitoring programme on the pollution hotspots attempted a critical investigation on the incidence of toxic dinoflagellate blooms in the coastal waters. The Institute had participated in a pilot expedition to the southern ocean on board *ORV Sagar Kanya* and gathered data on hydrography, plankton and marine mammals in the region up to sub Antarctic waters.

In the area of mariculture, the Institute continued its efforts in technology development and transfer. There were two significant achievements. The scientists of the Institute achieved a major breakthrough in breeding and hatchery production of the commercial important slipper lobster *Thenus orientalis*. India is the second country in the world to be successful in captive breeding and larval rearing of this economically important lobster. The other notable achievement was in the basic work for developing a tissue culture technology for marine pearl production using Indian pearl oyster and abalone. This breakthrough is a global first, achieved by the scientists of the Institute. During the year, several more women self-groups and fishers have taken up the mussel farming programme for income generation and alternate employment in Kerala, Karnataka and Maharashtra.

During the year, the Institute had furthered its capacity building in the frontier areas of biotechnology research, including disease diagnostics and management, bioactive compounds, formulated feed technology and DNA-based techniques on taxonomy and stock structure analysis.

The Institute generated a total income of Rs. 20,09,133 through consultancy projects on environmental monitoring, aquarium setting and lobster fattening. The animation film “Little Fishes and Tiny Nets” conceived and produced by the Institute under NATP was short listed for award in the prestigious Global Environment Film Festival 2003 held at Tokyo.

Institute library at headquarters was automated with fully integrated multi-user software. The Institute had brought out a book entitled “Status of exploited marine fishery resources of India”, one volume of Indian

Journal of Fisheries and other in-house publications, such as Marine Fishery Information Service, News Letter and Special Publications in Hindi “Matsyagandha” and “Samudra krishi ki nayi pragathiyam”.

The institute has filed 3 patent applications during the period under report. The Institute won the *Rajarshi Tandon Award* for the second best Hindi Implementation in ICAR for the year 2002-03 and the first position for the year 2003-04. The Institute also won the Best ICAR Annual Report Award for the year 2001-2002.

Under human resource development, the Institute organized 24 training programmes and 82 courses in key areas of marine fisheries and mariculture through KVK, apart from offering the M.F.Sc and Ph.D programmes in mariculture. The students of the PGPM won awards for best M.F.Sc dissertation and quiz competitions. To improve the skills in leadership qualities, interpersonal relationships and group work culture ethics, the members of the staff of the Institute were given training on HRD.

The summary and results of the research work carried out by the Institute during 2003-04 are furnished in this report. The staff of the Institute has contributed significantly toward the accomplishments made by the Institute and I would like to place on record my appreciation of the good work carried out by each one of them. I am thankful to Dr. Mangala Rai, Director General of ICAR for the support extended to achieve our targets. The Institute has received unstinted support of the fisheries division of ICAR and I place on record our sincere thanks to Dr. S. Ayyappan, Deputy Director General (Fy.), Dr. A.D. Diwan, Assistant Director General (M.Fy.), Dr. V.R. Chithranshi, Assistant Director General (I.Fy) and Shri. Anil Agarwal, Principal Scientist (M.Fy.).

Cochin
19 November 2004

MOHAN JOSEPH MODAYIL
Director

EXECUTIVE SUMMARY

On a mission to ensure the sustainability of the marine fishery resources of the country, the CMFRI was able to carry out research work on 51 in house projects, 19 sponsored projects, 13 NATP projects, 2 revolving projects and 6 consultancy projects during the period 2003-04.

Capture fisheries

The marine fish landings for 2003 were estimated at 2.66 million t, 1.5% more than that of the previous year. Increased landings of oil sardine, lesser sardines, Bombay duck, croakers, mackerel, seerfish, penaeid prawns and cephalopods contributed to this increase. Perches, ribbonfish, carangids and non-penaeid prawns showed marginal decline.

The west coast accounted for 67% of the total landings. Contributions from mechanized sector were to the tune of 66%, those of motorized sector 27%, and artisanal 7%. A generalized fishery development model revealed that about 40% of marine fishery resource was either in mature or senescent stage and the estimated total potential yield is 3.16 million t.

The total landings of *Sardinella* spp were 4.8 lakh t, of which oil sardine formed 3.7 lakh t and the rest the lesser sardines. A study on the trends in time series data of oil sardine on rainfall indicated good correlation between the two. The species is presently exploited at MSY level and no special management options are needed to regulate the fishery. The monsoonal trawl ban did not have any influence on the sardine catches. Truss morphometric analysis showed vertical segregation of clusters in sub-adults and horizontal segregation in the adults, indicating the possibility of mixing of older populations.

The present exploitation of anchovies is below the optimum level in Kerala, Karnataka and Maharashtra. The estimated anchovy production was 0.79 lakh t.

The overall exploitation ratios of king seer (*Scomberomorus commerson*) and spotted seer (*S. guttatus*) were higher along both the coasts, indicating that these species were exposed to higher fishing pressure during 2003.Young fish (<340 mm) were targeted along east coast in small meshed gill nets. Use of large meshed gill nets and hooks & lines could check growth and recruitment overfishing in seerfish. Further, operation of these needs to be extended to harness the untapped stock in the offshore waters.

The total tuna and billfish landings during 2003 estimated at 0.56 lakh t showed an increase of 4% over the previous year's landings. Drift gill net was the major gear. Mackerel landings, estimated at 1.12 t, have also shown increase during this year. This species was exploited more or less moderately at all other centers except at Calicut, where it was overexploited by ring seines.

Large-scale landings of juveniles appeared abundantly in Bombay duck fishery. Mesh regulation is urgently called for. Stock of ribbonfish *Trichiurus lepturus* appears to be stressed, because of the heavy fishing pressure along the west coast. Decrease in mean length and yield rates was noticed at most of the centers. In several species of carangids the exploitation was close to MSY levels. The fishery has shown a general declining trend from 1995.

The institute, under the INARIS programme of NATP, updated the catch table of Fishery Statistics databases (production statistics and export). Through a project financed by World Fish Center, Penang, Malaysia, the institute also catalogued existing and pipeline mariculture technologies in India.

The all India elasmobranchs landings contributed to 2.19% of total marine fish landings during 2003 indicating a marginal decline by 2.37% over the previous year. Rays registered increase in catch, while sharks and skates declined. In rays, females dominated the catches. Differential growth appears to take place in the two sexes during the gestation period itself. The all India landings of groupers during 2003 were 15222 t, which indicated a steep decline by about 40% in comparison to 2002. Mostly juveniles and immature fishes dominated the catch consisting mainly of *Epinephelus diacanthus* in the west coast.

Catfish catches of northern maritime states showed an increase during the year. Studies on growth, mortality and exploitation level of threadfin breams indicated that they are currently exploited at optimum level. Catches of croakers have increased by 1.52% during this year, with a total of 18 species representing the landings. Decline in sciaenid landings over the years was probably due to heavy capture of juveniles. Greater species diversity of lizardfishes was observed along the east coast. In most of the centers the resource was under heavy fishing

pressure. Off Visakhapatinam, *Saurida undosquamis* was overexploited. Flatfish constituted 1.8% of total marine fish production in 2003. Stock assessment studies of *Cynglossus macrostomus* at Calicut indicated that the species is underexploited. Similarly at Chennai, goatfish *Upeneus taeniopterus* is also exploited below the MSY. A new record of flatfish, *Aesopia cornuta* was reported from Malabar area.

Bottom trawling off Mangalore coast has resulted changes in TSS, dissolved oxygen, phosphate, silicate, chlorophyll and extinction coefficient. Fishing in shallow waters produce more discards including juveniles as compared to deeper waters. Artificial fish aggregating devices at Chennai helped to generate fish catch of 2694 Kg worth of Rs. 1,11,197, consisting chiefly of snappers, carangids, breams and pomacentrids.

Crustacean landings have shown marked improvement during 2003 constituting 16.5% of total marine annual landings. Penaeid (49.6%) and non-penaeid shrimps (31.7%) were the dominant groups. At Calicut, exploitation rate of shrimps was close to MSY. Deep-sea shrimps were caught in good quantity off Andhra coast. Decline in non-penaeid shrimps in dol not fishery was due to poor catches of *Acetes* spp. Decline in lobster catches in Gujarat during 2003 was noteworthy, which calls for special attention. Taxonomic studies on shrimps, lobsters, crabs and stomatopods were continued in 6 centres.

All India cephalopod production in 2003 showed 22% increase over 2002 mainly related to the production at Maharashtra. Exploitation rate of *Loligo duvauceli* was high along both coasts. *Sepia aculeata* and *S. pharonis* were exploited above optimum level at some centers, whereas they were underexploited at other centers. All India production of bivalves was 48,792 t showing 16% increase over that of 2002. Emergence of green mussel fishery in the high saline zones of estuaries of Kerala and south Karnataka coast during the late post monsoon and pre monsoon periods mainly contributed to the increased production.

Trophic model of Arabian sea off Karnataka coast, constructed using ECOPATH, indicated that the gross efficiency of the ecosystem is in the process of achieving full maturity. Simulation exercises using ECOSIM for the Karnataka coast fishery shows that the yields of large benthic carnivores (mainly *Pristipomoides filamentosus* and rock cods) can be markedly improved by increasing the effort.

Mariculture

The Three spot damsel fish (*Dascyllus trimaculatus*) and the himbug damsel *D. aruanus* were bred in captivity. About 2 million PL of *Penaeus semisulcatus* were sea ranched in the Gulf of Mannar during the reporting year. Success in breeding and hatchery production of the high valued ornamental shrimp *Stenopus hispidous* was achieved at the Calicut Research Centre. A major breakthrough in breeding and hatchery production of two species of scyllarid lobsters, *Thenus orientalis* and *Scyllarus rugosus* was achieved at Kovalam Field Laboratory, Chennai. Larval cycles of *T. orientalis* and *S. rugosus* were completed in 26 and 32 days respectively. In *T. orientalis* survival from phyllosoma I to postlarva ('nisto') was 22% and from nisto to juvenile 100%. Standards for hatchery production of organic shrimp seeds and farming of *P. semisulcatus* were developed. Under an MPEDA-sponsored project stakeholder participation in conservation measures of lobsters was continued.

A Semi automated mussel seeding machine developed at CMFRI was field tested with farmers' participation in Kollam, Malappuram and Kozhikode districts in Kerala. Awareness campaigns were held on edible bivalve farming intensified by conducting training programmes and setting up demo farms in different parts of the country. Initial success was achieved in breeding the Big finned squid *Sepioteuthis lessoniana*. Also, *Sepia pharonis* was reared from egg to mature stage in 5 months.

A major breakthrough was achieved in the basic work for developing a tissue culture technology for marine pearl production using *P. fucata* and abalone *Haliotis varia* for the first time in the world. This technology can be extended to other pearl producing molluscs. Juveniles of *Babylonia spirata* produced in the hatchery attained 30 mm length and 5.3 g in 9 months, with a growth rate of 0.06 mm/day.

The mussel farming programme under NATP motivated several villagers to take up this mariculture technology for income generation and alternate employment in Kerala and Maharashtra. A prototype for simple continuous flow through system for depuration was developed. The technology for mabe pearl production was further refined by standardizing the technique for production of base images with 10 different types of moulds.

Experimental culture of *Gracilaria edulis* under onshore culture system showed a maximum increase in biomass of 26% after 42 days culture period. Experimental farming of *Kappaphycus* along the west coast showed a crop growth rate of 16 g/day. Spawning technique of *Holothuria scabra* was standardized.

Environmental & Biodiversity studies

It was observed that copper content from hotspots in Veraval and Tuticorin and Zinc content in Ennore river mouth at Chennai near the North Chennai Thermal Power Station were exceeding the EPA safe levels given for aquatic organisms.

Speciesdiversity of calanoid copepods was higher in the east coast than in the west coast. Two species were found to be endemic to the northwestern part of the Bay of Bengal and four species to the Andaman-Nicobar waters. Blooms of dinoflagellates were observed in many sites along the Kerala coast and associated fish and shellfish mortality was recorded at Thankassery in October 2003.

Under a DOD-sponsored project, the institute participated in pilot expedition on board *ORV Sagar Kanya* and generated information on hydrography, plankton and marine mammals of southern ocean up to sub Antarctic waters. Research findings of a project to assess impact of altered river flow on the nutrient and productivity profile of west coast waters have important implications in the context of river linking project.

Biotechnology

Director General, ICAR formally released duplex PCR kit and formulated pellet feed for mud-crab fattening and marine ornamental fish. Rights for production and marketing of the duplex PCR kit developed by CMFRI have been transferred to a private company on payment.

Fermented product from a mixture of soybean flour and oil cake was successfully used as partial substitute for fishmeal in shrimp feed. Two strains out of 15 bacterial isolates tested showed high antagonism against pathogenecity, their potential use as gut probiotics in disease management is revealed. Lysozyme was purified from the crystalline style homogenate of green mussel, *Perna viridis*. A phytase producing Bacillus strain has been isolated from mangrove swamp and partially purified.

Study based on DNA polymorphisms showed that the sample of *Nemipterus japonicus* from Paradeep was distantly related to Cochin and Chennai samples. Stock homogeneity was evident in *N. mesoprion.* Phylogenetic relationships in four species of marine ornamental fish *Amphiprion* were delineated and putative sex-specific markers were developed in domesticated *A. sebae.*

Extension & Economics

Price spread and monthly price fluctuations of different species of fishes at landing centers, wholesale and retail levels were studied. Fishermen earned comparatively better share of about 70% of the consumer rupee for species like sharks, seer fish and penaeid shrimps. Low operating ratios for single day fishing were found in Andhrapradesh (0.41) and Kerala (0.62). Labour and fuel costs had significant positive influence on gross income. Under IVLP, 13 types of interventions were implemented at Elamkunnapuzha village of Vypeen island in fisheries (4), livestock (3) and agriculture (6).

The ATIC had generated an income of about 1 lakh rupees during 2003 through diagnostic services, laboratory tests and sale of value added fishery products, publications and other technological inputs. The animation film *Little Fishes and Tiny Nets* conceived and produced by the institute was shortlisted in the prestigious Global Environment Film Festival 2003 held at Tokyo.

Publications, New projects & Recognitions

Staff of the institute had published a total of 45 research papers in peer-reviewed journals, 119 technical articles and 57 papers in seminars/symposia. CMFRI won the Rajarshi Tandon Award for second best Hindi implementation in ICAR for the year 2002-03 and first position for the year 2003-04. The Institute also won the best ICAR Annual Report Award for the year 2001-02. Various programmes for competency development in Hindi were organized during 2003. Three new projects on broodstock development of blue crab, technological upgradation of edible oyster farming and economic evaluation of trawl fishing were approved under ICAR Ad hoc scheme for implementation.

Training & Education

Under the education programme, 14 regular students and scholars of sponsored projects of the institute were awarded Ph D degrees during 2003. One MFSc student was awarded *Dr N.R. Menon award* for the best dissertation. Two students won prizes in the Inter-collegiate Quiz competition held at Trivandrum. KVK conducted 24 training programmes and 82 courses during the reporting year. Members of the Staff of the institute were also given training on HRD, chiefly to improve their skills in leadership qualities and inter personal relationships.

INTRODUCTION

India is endowed with a long coastline of 8,129 km, 0.5 million sq km of continental shelf, 2.02 million sq km of EEZ and an estimated annual Marine Fishery Resource Potential of 3.9 million t. The vast areas along the coastline offer ideal sites for seafarming and coastal mariculture. The Indian marine fisheries sector plays a significant role in supplying protein-rich food to the increasing population, employment generation and foreign exchange earning. The present marine fisheries scenario in India is characterised by declining yields from the inshore waters, increasing conflicts between different resource users, increasing demand for sea-food for domestic consumption and export and prospects for large scale seafarming and coastal mariculture. This warrants greater and more effective R&D efforts to enable implement suitable action plans for sustained marine fisheries and mariculture development.

The Central Marine Fisheries Research Institute (established in 1947) is the nodal agency in India, responsible for research support in marine fisheries development. Over the period of 56 years since its inception, the CMFRI grew significantly in its size and stature by building up a fairly adequate research infrastructure and recruiting suitably qualified R&D staff. The Institute's multidisciplinary approach to research in marine capture and culture fisheries has won the recognition as a premier Institute comparable to any well-established marine fisheries laboratory in the world.

The Mandate

To monitor the exploited and assess the under-exploited marine fisheries resources of the Exclusive Economic Zone .

To understand the fluctuations in abundance of marine fisheries resources in relation to change in the environment.

To develop suitable mariculture technologies for finfish, shellfish and other culturable organisms in open seas to supplement capture fishery production.

To act as a repository of information on marine fishery resources with a systematic database.

To conduct transfer of technology, post graduate and specialized training, education and extension education programmes.

To provide consultancy services.

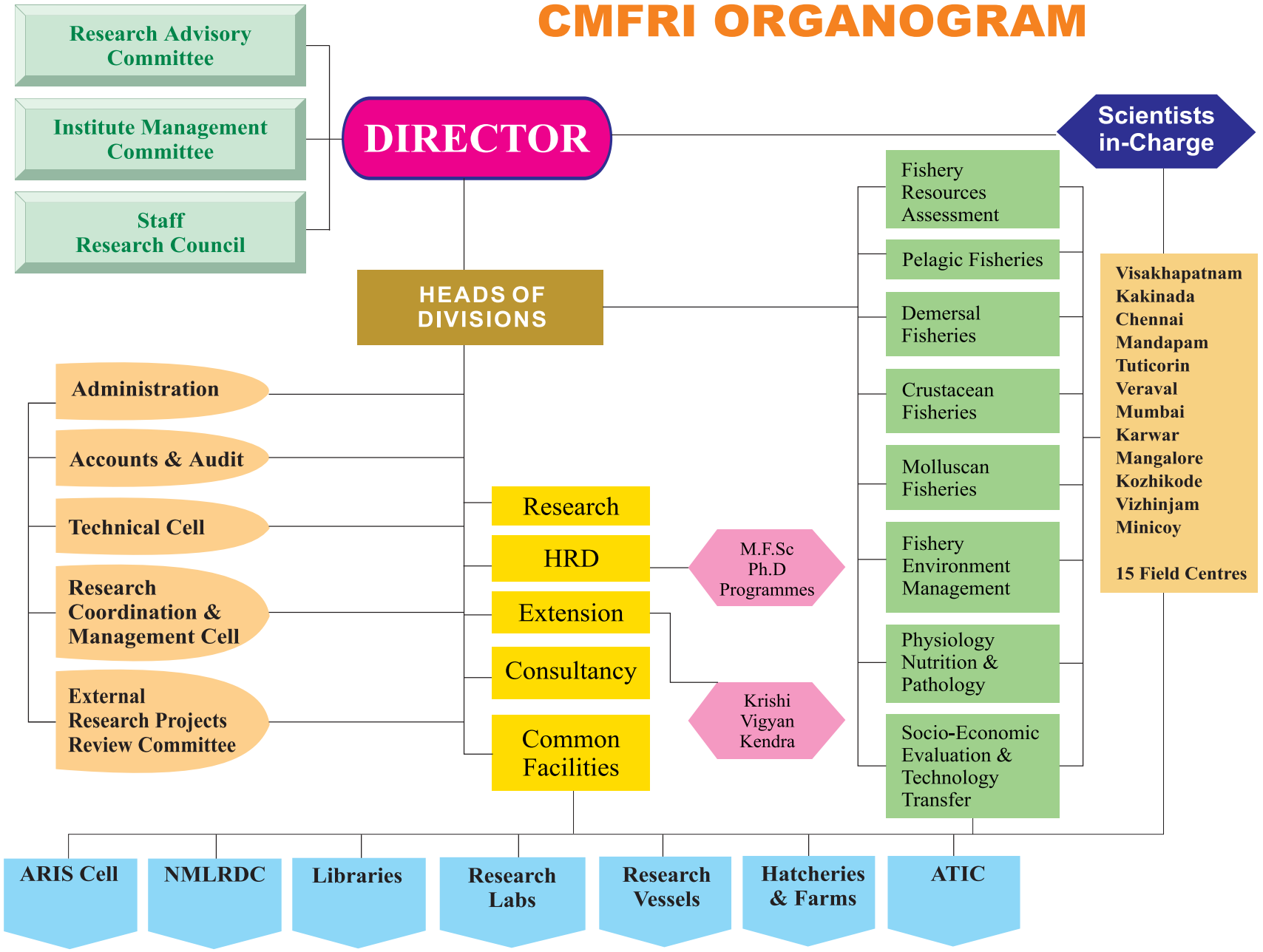
To accomplish its mandate, the Institute monitors the landings on a continual basis from all along the country's coast, conducts researches on characteristics of exploited marine fish stocks; carries out exploratory surveys and assesses the under - and unexploited resources, develops seafarming techniques, undertakes research in fishery environmental characteristics and sea-dynamics and conducts postgraduate education programmes leading to M.F.Sc. and Ph.D. degrees. Studies are also conducted on economics of fishery enterprises and socio-economic conditions of fisherfolk.

The organisational set-up

To effectively carry out these tasks, the Institute has established Regional Centres at Mandapam Camp, Veraval and Visakhapatnam, Research Centres at Minicoy, Mumbai, Karwar, Mangalore, Kozhikode, Vizhinjam, Tuticorin, Chennai and Kakinada and 15 Field Centres all along the coast. The entire activity is coordinated by the Headquarters at Cochin. The Institute has, over the years, built up laboratory and field facilities for carrying out research programmes and has been upgrading the same to meet the changing needs and additional requirements. The sanctioned staff strength of the Institute is: Scientific 190, Technical 350, Administrative 156, Auxiliary 6 and Supporting 291.

The multidisciplinary researches in capture and culture fisheries are conducted under eight Divisions: Fisheries Resources Assessment, Pelagic Fisheries, Demersal Fisheries, Crustacean Fisheries, Molluscan Fisheries, Fishery Environment Management, Physiology, Nutrition and Pathology and Socio-economic Evaluation and Technology Transfer. Interdivisional and interinstitutional programmes are carried out for greater utilisation of expertise and facilities. Besides, the Institute also

CMFRI ORGANOGRAM



Budget 2003 – 2004

(Rs. in lakhs)

(Rs. in lakhs)

Sl. No.	Sub Head	Budget Allocation for the F/Y 2003-2004	Expenditure for the F/Y 2003-2004
NON PLAN			
1	Estt. charges	1270.20	1270.20
2	O.T.A.	1.20	1.20
3	T.A	16.00	15.92
4	Other Charges	390.00	373.10
5	Works	170.00	190.51
6	Other Items	3.60	-
	TOTAL	**1851.00**	**1850.93**
PLAN			
1	Estt. charges	-	-
2	T.A.	30.00	30.00
3	(1) Other Charges (cont.) including HRD Rs.2 lakhs	126.00	128.58
	(a) Equipment	40.00	37.81
	(b) Library	20.00	19.79
	(2) Information Technology	5.00	4.82
4	Works		
	1. Works as per EFC		
	(a) Special Repairs		
	(b) Major works	112.00	112.00
	2. One time Catch-up-grant		
5.	Other items	-	-
	Total	**333.00**	**333.00**

Externally Funded Research Projects

S.No.	Fund Source	Receipts during the year	Expenditure during the year
1	AP Cess Fund	26.16	17.85
2	DOD	19.94	12.72
3	DBT	0.08	0.21
4	DST	1.25	1.46
5	MoEF	-	2.15
6	MPEDA	10.40	3.32
7	KSDF	-	4.51
8	IFS	-	0.02
9	IGIDR	3.31	3.29
10	NATP	66.63	67.36
11	World Fish Centre	0.25	0.33
	Total	**128.02**	**113.22**

takes up short-term research projects on important and priority areas through *ad hoc* research projects funded by outside agencies in the country and abroad, and offers consultancy services to the clients from Government organisations as well as private industry.

Under the Postgraduate Programme in Mariculture, the Institute organises M.F.Sc. and Ph.D programmes of the Central Institute of Fisheries Education, Mumbai, a Deemed University under the ICAR. The teaching programme is carried out by the scientists of the Institute.

The *Krishi Vigyan Kendra* imparts training in mariculture, agriculture, animal husbandry and other related subjects to fish farmers, agricultural farmers and farm women.

The Library and Documentation Section provides reference facilities to research staff and students of the Institute as well as to visiting scientists both within and outside the country.

The results of research carried out in the Institute are published in various journals. Besides, the Institute brings out Bulletins, Special Publications and the Marine Fisheries Information Service and publishes the Indian Journal of Fisheries.

Posts	Sanctioned	Filled	Vacant
Scientists	190	123	67
Technical	350	336	14
Administrative	156	143	13
Supporting staff	291	243	48
Auxiliary	6	6	6

FISHERY RESOURCES ASSESSMENT DIVISION

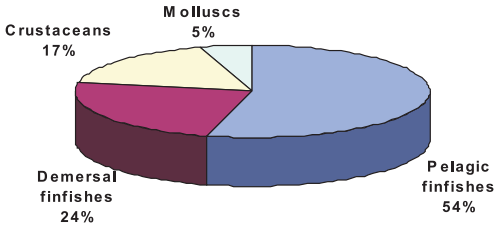
Fisheries Resources Assessment Division is primarily responsible for the fulfillment of the Institute mandate of monitoring and assessing the exploited fish stocks in the Indian EEZ. The Division carried out 4 inhouse research projects on development of methodologies on data collection for fishery monitoring and assessment, and also on methods and models for assessment of status of the exploited stocks. A three-year DOD funded project on predictive modeling in Marine Fisheries of the southwest coast of India was initiated during the period. The Division, besides its research activities, also maintained the National Marine Living Resource Data Centre (NMLRDC), the ARIS Cell, Computer Centre and the Institute Website.

The Scientists of the Division served as faculty members in the Post-graduate Programme in Mariculture. Two of the Scientists served as the research guides of M.F.Sc students for their dissertation work. One scientist was sent as a member of the C.M.F.R.I. team to represent India at the workshop on Fisheries Resource Information and Tools (FiRST) during 12th and 13th August 2003 at World Fish Centre Headquarters, Penang, Malayasia. The Institute offered technical advice to the World Fish Center, Penang, Malaysia for the Project on Global Public Goods – Databases: FiRST (Trawl base) upgrade project 2003 during 1-5 December 2003 and advised on the methodology for estimation of biomass for the biomass module of FiRST.

The Division was able to obtain a grant of Rs. 80 lakhs from the Department of Animal Husbandry & Dairy, Ministry of Agriculture to conduct an "All India Marine Fishermen Census". The Division prepared the necessary schedules, publicity materials etc. for organizing the all India census on marine fishermen population, implements and infrastructure facilities during early 2005.

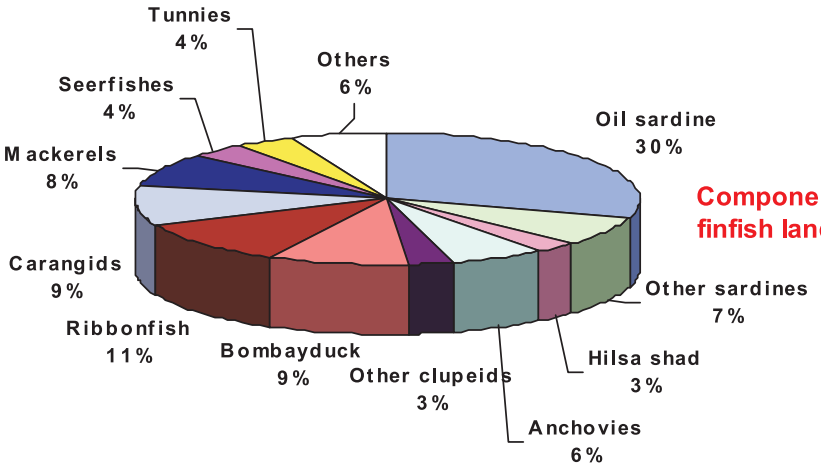
A training programme on **Multivariate Statistical Methods for Fisheries Research** was organized for 12 participants from various research organizations and state agricultural universities from 18th March to 7th April, 2004.

PROJECT CODE	**FRA/ASSESS/01**
PROJECT TITLE	**Assessment of exploited marine fishery resources**
SCIENTISTS	**K. Balan**, M. Srinath, K. Vijayalekshmi, T.V. Sathianandan, Wilson T. Mathew, Somy Kuriakose and Mini, K.G.
CENTRES	Cochin

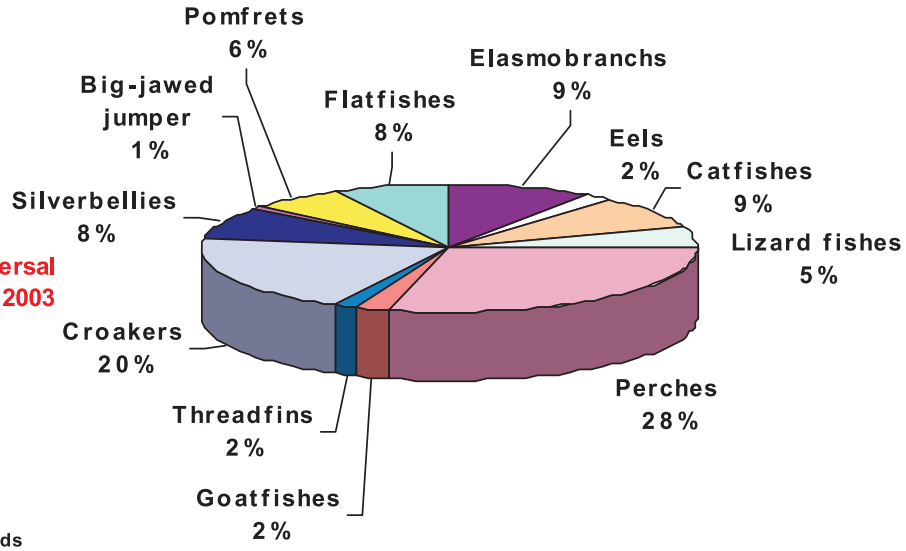


Components of marine fish landings in India, 2003

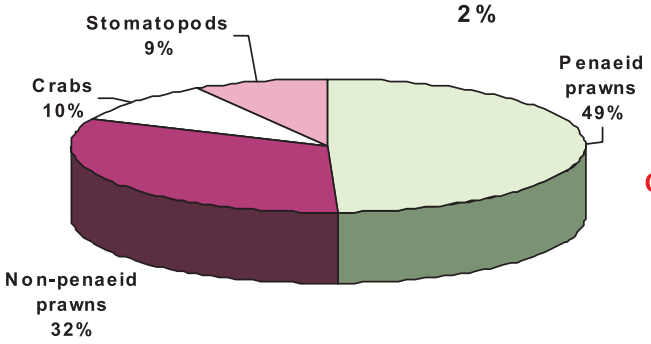
- The marine fish landings of India during the year 2003 has been provisionally estimated at 2.66 million tonnes which recorded a slight improvement of 39000 t (1.5%) against the estimate of the previous year.
- Among the commercially important groups, fishery of oil sardine, lesser sardines, Bombayduck, croakers, mackerel, seerfishes, penaeid prawns and cephalopods recorded higher than the previous year catches.
- The fishery of perches, ribbonfishes, carangids and non-penaeid prawns recorded less than the previous year landings.
- The estimate of regionwise production showed that the north east region, comprising West Bengal and Orissa coasts contributed 9.9%



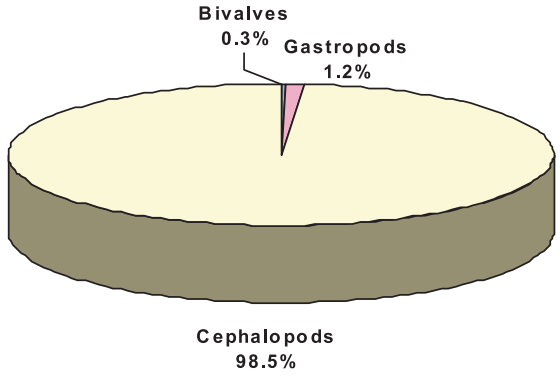
Components of pelagic finfish landings, 2003



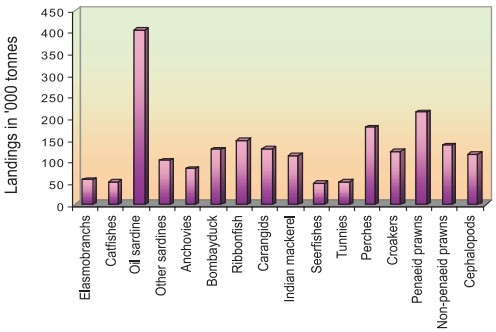
Components of demersal finfish landings, 2003



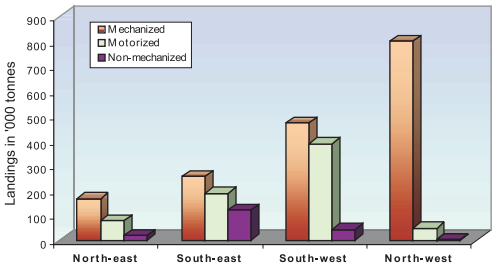
Components of crustacean landings, 2003



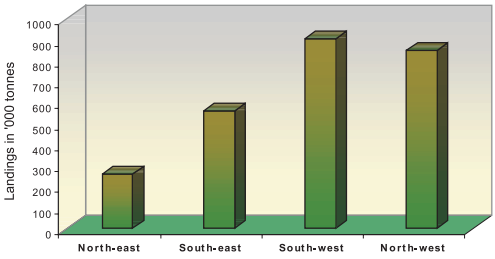
Components of molluscan landings, 2003



Landings of major fishery resources during 2003



Sector-wise landings in different regions, 2003



Region-wise landings in India, 2003

to the total production. South east region consisting of Andhra Pradesh, Tamil Nadu and Pondicherry coasts contributed 21.9%. On the west coast, southwest region comprising Kerala, Karnataka and Goa coasts recorded 33.2% of the total, whereas, the northwest region comprising Maharashtra and Gujarat coasts contributed a maximum of 33.7%.

- The contribution of mechanized landings during the year 2003 was 66%, motorized 27% and artisanal 7%.
- The pelagic finfishes constituted 56%, demersal fishes, 22%, crustaceans, 17% and molluscs 5% of the total landings.
- Oil sardine recorded an all time high landings of 3.77 lakh tonnes during the year. Compared to the estimate of 2002, an increase of 33,000 t (9.6%) was noticed.
- The Bombayduck fishery showed a slight improvement of 7,000 t with an estimate of 1.3 lakh tonnes during 2003.
- The landing of croakers were 1.25 lakh tonnes, with a marginal increase of 1,800 t.
- An increase of 14,000 t was observed in the landing of penaeid prawns, the estimate being 2.2 lakh tonnes during 2003.
- Cephalopod fishery also improved considerably during 2003 with an increase of 23,600 t with an estimate of 1.28 lakh tonnes.
- The landing of perches recorded a decline of 25,000 t, with an estimate of 1.78 lakh tonnes.
- The estimated landing of ribbon fishes were 1.82 lakh tonnes, which recorded a decline of 15,000 t.
- The landing of carangids were 1.22 lakh tonnes with a slight decline of about 4,400 t.
- The non-penaeid fishery also witnessed a decline of about 5,000 t with an estimate of 1.32 lakh tonnes.

PROJECT CODE	**FRA/ASSESS/02**
PROJECT TITLE	**Stock assessment techniques in marine fish and shellfish resources and management**
SCIENTISTS	**M. Srinath**, T.V. Sathianandan, Wilson T. Mathew and Somy Kuriakose
CENTRES	Cochin

- A macro-analysis of the top 51 resource-area fishery accounting to 75% of the marine landings was carried out based on the time series of landings from 1961 to 2002.
- A generalized fishery development model (FAO,1996) was applied to the resource-area combination. About 40% of the resources were either in the mature or senescent stage. There is less likelihood of increased landings from these resource groups. Even among the groups in the developing phase, the trends indicated tendency of the fisheries towards the asymptotic levels of production.
- The long term potential yield was 2.72 million tonnes and the average long term potential yield was estimated at 2.58 million tonnes. Using

the empirical model the expected maximum yield was estimated at 2.53 million tonnes based on all India landings. The model was tested for total landings by region, which gave an estimate of 3.16 million tonnes.

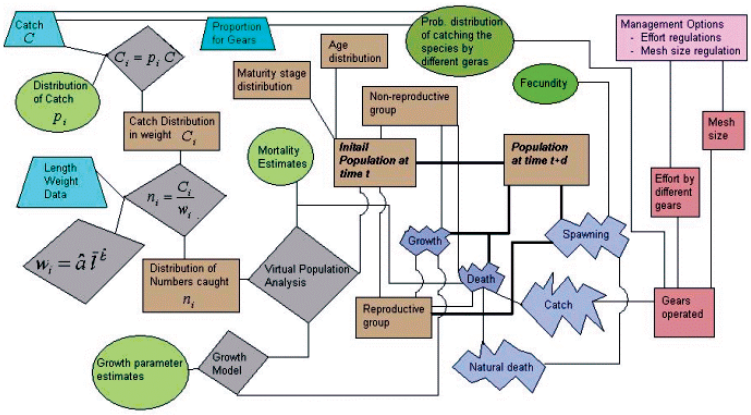
- The estimated values of potential yield indicate that there will not be significant improvement in the landing from the current level of production

PROJECT CODE	**FRA/MOD/02**
PROJECT TITLE	**Determination of optimum sample size to evaluate the catch and effort for use in marine fisheries**
SCIENTISTS	**M. Srinath**, K. Vijayalekshmi, Somy Kuriakose and Mini, K.G
CENTRES	Cochin

- The Monte Carlo Bootstrap methodology was applied to evaluate the sampling scheme, in terms of coefficient of variation, to determine optimum number of days for estimation of total landings from the selected single centre zones. Monthly data on landings during 2002 was considered for the study.
- The bootstrap software for this study was developed in C language.
- The bootstrap was done only for the first stage and the Coefficient of Variation was estimated for bootstrap sample of sizes 500, 1000, 1500, 2000 and 5000. The monthly coefficients of variation for different sample sizes starting from sample size of 3 days were calculated.
- It was found that for a precision level of 10 to 15%, 10-12 days of observations per month would be sufficient to estimate the landings.

PROJECT CODE	**FRA/MOD/03**
PROJECT TITLE	**Application of simulation models for fisheries management game**
SCIENTISTS	**T.V. Sathianandan,** M. Srinath, K.S. Mohamed, Somy Kuriakose and Mini, K.G
CENTRES	Cochin

- Developed a conceptual model for single species fishery incorporating biological factors along with other fishery related factors. This model forms the basis for the development of a fishery management game.
- Developed a macro level simulation model based on surplus production model to simulate effects of closure of fishery.



Estimated Marine Fish Landings (t) during 2002 and 2003

Pelagic finfish		
Name of fish	**2002**	**2003**
CLUPEOIDS		
Wolf herring	16906	14743
Oil sardine	344103	403952
Other sardines	102885	102394
Hilsa shad	23758	37897
Other shads	5935	6230
Coilia	39760	35554
Setipinna	6556	5371
Stolephorus	44057	41908
Thryssa	32229	27894
Other clupeids	43608	37762
BOMBAYDUCK	123029	127408
HALF BEAKS&FULL BEAKS	5922	5649
FLYING FISHES	6236	4881
RIBBON FISHES	197106	148386
CARANGIDS		
Horse Mackerel	21230	30927
Scads	38625	28493
Leather-jackets	6238	10524
Other carangids	60214	59093
MACKERELS		
Indian mackerel	95573	113439
Other mackerels	19	5
SEER FISHES		
S. commersoni	36238	34141
S. guttatus	16389	15308
S. lineolatus	14	0
Acanthocybium spp.	24	24
TUNNIES		
E. affinis	24421	21793
Auxis. spp	11833	15131
K. pelamis	3117	2393
T. tonggol	6350	3861
Other tunnies	4401	9176
BILL FISHES	4126	4631
BARRACUDAS	17740	14997
MULLETS	6372	4891
UNICORN COD	891	900
MISCELLANEOUS	62772	56696
Total	**1408677**	**1426452**

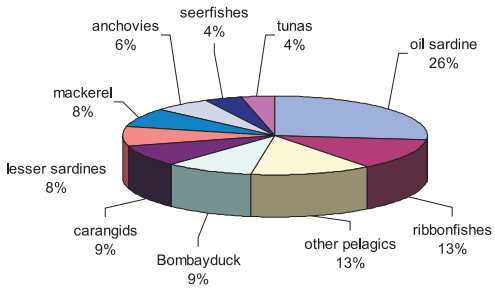
Demersal finfish		
Name of fish	**2002**	**2003**
ELASMOBRANCHS		
Sharks	37760	29912
Skates	2669	2633
Rays	19619	25126
EELS	9249	10313
CATFISHES	58202	53010
LIZARD FISHES	26490	29863
PERCHES		
Rock cods	25539	16890
Snappers	4966	6000
Pig face breams	11406	10547
Threadfin breams	110388	104925
Other perches	50188	40014
GOATFISHES	12029	12482
THREADFINS	9680	9465
CROAKERS	123395	121944
SILVERBELLIES	60856	48544
WHITEFISH	3985	3122
POMFRETS		
Black pomfret	12424	15678
Silver pomfret	25310	21712
Chinese pomfret	2042	1988
FLAT FISHES		
Halibut	1171	1167
Flounders	148	50
Soles	40429	44592
MISCELLANEOUS	30219	25248
Total	**678164**	**635225**
	Shellfish	
CRUSTACEANS		
Penaeid prawns	204070	214274
Non-penaeid prawns	137714	137229
Lobsters	1332	1248
Crabs	36192	42154
Stomatopods	48551	37341
MOLLUSCS		
Cephalopods	103990	117289
Miscellaneous	4759	1734
Total	**536608**	**551269**
Grand total	**2623449**	**2612946**

PELAGIC FISHERIES DIVISION

During 2003-2004 the Pelagic Fisheries Division implemented eight Institute Research Projects on economically important pelagic finfish resources. The Division continued to build up an application oriented database on catch, effort, catch per effort, species-wise catch and size composition and other biological parameters. Based on this database, the stock assessments of major pelagics were made. Five externally funded research projects were also implemented.

Of the total pelagic finfish landings during 2003, 66% was obtained from the west coast and 33% from the east coast. The contributions of major pelagic finfish species were: oil sardine (14.2%), ribbonfish (7%), Bombayduck and carangids (5% each), lesser sardines, anchovies and mackerel (4% each), tuna and seerfish (2% each). Oil sardine landings, which had peaked at 3.67 lakh t during 2000 remained high during 2003 with a production of 3.77 lakh t. Another major pelagic resource, the Indian mackerel showed signs of recovery from the progressive decline in catches experienced since 2001 when landings were at 88,288 t. Compared to the annual average decadal landing of 1.9 lakh t, the catches in 2003 were 1.12 lakh t. There was conspicuous absence of intensive recruitment to the fishery in the immediate post-monsoon period. Ribbonfish landings showed a decrease of 7% compared to previous year as targeted fishing of the stocks to meet increasing export demand from south-east Asian countries continued. Mean size of ribbonfish caught in trawls showed a decline along the east coast.

Annual estimates of population parameters and stock of tunas, seerfishes, mackerel, oil sardine, lesser sardines, whitebaits, ribbonfishes, carangids and Bombay duck were made.



Major components of pelagic finfish landings during 2003

PROJECT CODE	**PEL/CAP/1**
PROJECT TITLE	**Development of management strategies for sustainable fishery of sardines** *(Sardinella* spp.*)*
SCIENTISTS	**A.A. Jayaprakash,** Prathibha Rohit, M.Sivadas, E.M.Abdussamad, H.Mohamad Kasim and A.K.V.Nasser
CENTRES	Karwar, Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai and Visakhapatnam

- The total landings of *Sardinella* spp. were 4.8 lakh t, of which oil sardine formed 3.7 lakh t and the rest the lesser sardines. The oil sardine (*Sardinella longiceps*) landings continued to be high. The resource formed 14% of the all India marine fish production and 30% of the total pelagic fish landings.
- The west coast contributed to 87.3% and east coast, the rest.
- The lesser sardines accounted for 1.13 lakh t. 80% of the production was from the east coast.
- The ringseines operation off Rameswaram realised the highest C/E of 4.2t, followed by pair trawl (3 t), purseseines at Cochin (2.7t), at Karwar (0.8 t) and Mangalore-Malpe (0.7t), ringseine at Cochin (0.7 t) and Calicut (1.4 t), and the shore seine at Tuticorin (0.7 t). In other gears the C/E was less than 100 kg.
- The sustained fishery resulted in a dry fish trade, the bulk of which was sent from Alleppey and Calicut to Tamil Nadu for making poultry feed.

Contribution (%) of juveniles and pre-adults

Size (Tl) (mm)	Cochin			Calicut		Mangalore			Malpe		
	PS	RS	TR	RS	TR	PS	RS	TR	PS	RS	TR
0-100	0	40	18	15	0.6	29	0	1.1	3	0	52.5
105-140	96	7	78	56	17	43	45.7	13.1	53	79	15.9
>145	4	53	4	29	82.4	28	54.3	83.6	44	21	31.5

PS = purseseine, RS= ringseine, TR= trawl

An answer to fluctuations in abundance of oil sardine

- Trends in time series data sets on rainfall (1900 till date) and its onset dates in Kerala, sea level off Cochin and the sunspot activity were compared with oil sardine landings. The study revealed a decadal trend in the rainfall, sunspot activity and oil sardine production. A forecast model developed showed a lag of 4-6 years between rainfall and oil sardine abundance. Oil sardine being a primary consumer, the trend in population at intervals larger than its life cycle is a reflection of general productivity in the ecosystem. Like any land-based crop, the rainfall has sway in productivity of the sea also.

Migratory pattern of oil sardine

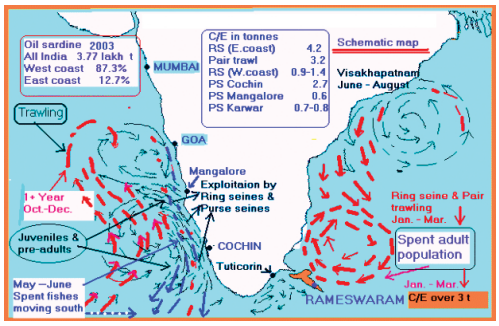
- The spawning - feeding migratory pattern of oil sardine along the west coast was charted out based on time series data on catch, C/E and size composition in various gears at different centres and past information obtained from tagging experiments.
- The density of the shoals (juveniles and pre-adults) north of Calicut was lower when compared to southern centres as revealed by the C/E in different gears. The stock of adult population was available in slightly deeper areas.

Stock assessment

- Oil sardine was exploited at MSY level in Karnataka and Kerala. MSY in Kerala was 2.54 lakh t and yield 2.41 lakh t. Nearly 52% and 64% of the MSY of *S.albella* and *S.gibbosa* remained under-exploited along the east coast.

Management options

- The large-scale exploitation of juveniles and pre-adults, as a consequence of massive recruitment, is no threat to the fishery. However, the forecast model evolved indicates a downfall in stock. This is due to the dry spell in rainfall that is continuing from the year 2000 which is unfavourable for this species, but favourable for other species like Indian mackerel. The trend in mackerel catch is a clear indication.
- The stock exhibited remarkable power of resuscitation which was linked to the periodicity in the intensity of SW monsoon rainfall. This has been confirmed with the pattern in abundance and decline observed earlier during 1968 (3 lakh t netted by non-mechanised sector). The present fishing employing modern vessels and gears



Migration pattern of oil sardine

could exploit only an additional 67,000 t.

- The exploitation of oil sardine stock by ring seines and pair trawlers around Rameswaram does not pose any threat to the stock as the catch constituted of only spent- recovering fishes.
- Along the east coast, lesser sardines remained under-exploited, i.e., below 50% of their MSY.
- There are inter-annual variations in the stock abundance and is exploited accordingly.
- The present trawl ban during June-July in Kerala has neither negative nor positive impact on the stock. This is because, except for the sporadic catches, the resource has never been a target species of bottom trawling.

PROJECT CODE	**PEL/CAP/2**
PROJECT TITLE	**Development of management strategies for judicious harvesting of anchovies**
SCIENTISTS	**Mohammad Zafar Khan**, Prathibha Rohit, A.A.Jayaprakash and H. Mohamad Kasim
CENTRES	Mumbai, Mangalore, Cochin and Chennai

- During 2003, the estimated anchovy production was 1.14 lakh t registering a marginal increase. whitebaits landings declined from 49,541 t (1999) to 42,637 (2003) but golden anchovy production fluctuated between 31,169 t and 38,316 t during the same period.
- The major gears employed were trawl, purseseine, ringseine and *dol* net. The trawl landings at Mumbai showed increasing trend whereas it declined at Cochin, Mangalore and Malpe. In the purseseine also the anchovy landings declined by more than 50%. However, the catches by ringseines showed an increase by 3.8 fold at Cochin. Golden anchovy landings increased by 89% in *dol* nets.
- The major species which contributed to the fishery were *Encrasicholina devisi, E. punctifer*, *Stolephorus waitei, S. macrops, S. indicus, S. commersonii* and *Coilia dussumieri.* The species composition of trawl gear was *E. devisi* (62.1%), *S. waitei* (30.9%) and *E. punctifer*(5.5%) while purseseine catch comprised of mainly *E. devisi* (95%).
- Mean size of *E. devisi, S. waitei* and *E. punctifer* are 84, 94 and 78mm respectively in trawl gear. Mean size of *E. devisi, S. waitei* and *E. punctifer* are 77, 92 and 77mm respectively in purse seine. Mean size of *C. dussumieri* is 150 and 133mm in trawl and *dol* net catches.
- The whitebaits resource remained under-exploited in the traditional fishing grounds on account of target fishing by trawlers in distant waters.

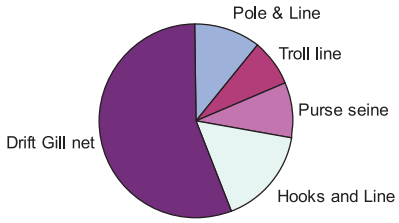
- *Stolephorus macrops* reappeared in ring seine catches in the second successive year, constituting 48.3% of the landings in the gear.
- About 70% catch of *Coilia dussumieri* was exploited by trawlers and only 30% by the artisanal gear *dol* net. The encroachment of trawlers into the traditional *dol* net areas is the cause of concern.
- The present exploitation of anchovies is below the optimum level in Kerala, Karnataka and Maharashtra.

PROJECT CODE	**PEL/CAP/3**
PROJECT TITLE	**Development of strategies for rational exploitation of seerfishes**
SCIENTISTS	**C. Muthiah**, N.G.K. Pillai, U.Ganga, E.M.Abdussamad, H.Mohamad Kasim and A.K.V. Nasser
CENTRES	Veraval, Mangalore, Cochin, Tuticorin, Chennai and Visakhapatnam

- All India seerfish catch was estimated at 0.55 lakh t during 2003 as against 0.52 lakh t in the previous year. The landings declined at Chennai (-21%) and Veraval (-12%) while it increased at Cochin (8%), Tuticorin (19%), Visakhapatnam (70%) and Mangalore-Malpe (97%). Gillnet, trawl and hook and line were the major gears contributing 50%, 35% and 9% respectively and purse seine and indigenous gears contributed the remainder.
- Four species contributed to the fishery, the major species was king seer *Scomberomorus commerson* (78.5%) followed by the spotted seer *S.guttatus* (20.5%). The other two species, the wahoo *Acanthocybium solandri* and the streaked seer *S.lineolatus* together contributed about 1%.
- Length-range of king seer was 12 - 144 cm with a mean size of 67 cm in large mesh size gillnet, 86 cm in hooks and lines and 36 cm in trawl. Young fish (<34 cm) were caught abundantly by trawl. For spotted seer the length range was 20-64 cm with a mean length of 44 cm in drift gillnets and 36 cm in trawl nets and 41 cm in hook and lines.
- Stock assessment studies indicated higher fishing mortalities for young king seer (23-30 cm) by trawl and higher length groups (74-78 cm and 90-94 cm) by gillnet along the west coast of India. In the case of spotted seer, fish above 38-40 cm were exposed to higher fishing pressure. Overall the exploitation ratio (E) was found to be higher for both the species along both west and east coasts of India, indicating that these species were exposed to higher fishing pressure during 2003.
- The standing stock along the west coast of India was estimated to be 9,542 t against the present yield of 13,169 t (trawl 3,201 t and gillnet 9,968 t) for kingseer and 5,142 t against the present yield of 9,549 t (trawl 2,154 and gillnet 7,394 t) for spotted seer. Results of Thompson and Bell multifleet analysis indicated that for kingseer, a maximum yield of 14,382 t (3,017 t in trawl and 11,365 t in gillnet) would be obtained if the gillnet effort is kept constant at the present level while the present trawl effort is reduced by 20%. In the case of spotted seer, an optimum yield of 9,598 t (2,186 t in trawl and 7,412 t in gillnet) would be obtained when the present trawl effort is reduced by 40%.
- The management option proposed for sustained exploitation of seerfish resources in the Indian waters against growth and recruitment overfishing is to encourage the large mesh gillnet and hook and line exploitation and increase the trawl mesh size. Further, the operation of these gears may be extended to deeper waters in order to increase the production from the untapped portion of the stock available in the offshore waters.

PROJECT CODE	**PEL/CAP/4**
PROJECT TITLE	**Development of strategies for sustainable exploitation of tunas, tuna live-baits and billfishes**
SCIENTISTS	**N.G.K. Pillai**, C.Muthiah, U.Ganga, G.Gopakumar, E.M.Abdussamad, H.Mohamad Kasim and K.P.Said Koya
CENTRES	Veraval, Mangalore, Cochin, Vizhinjam, Tuticorin, Chennai and Minicoy

- Annual average tuna production (1998-2003) by Indian fleet from our EEZ is about 47,000 t of coastal and 10,000 t of oceanic tunas. Thus, presently only 23% of the annual potential yield of coastal tuna are harvested while with regard to oceanic tuna it is mere 6%.
- The coastal and neritic tunas (*E. affinis*, *Auxis* spp. and *Thunnus tonggol*) contributed 85% of the total tuna landings (0.56 lakh t), the rest constituted by oceanic species such as yellowfin *Thunnus albacares* (juveniles) and skipjack *Katsuwonus pelamis*. Among billfishes, sailfish (*Istiophorus platypterus*) dominated.
- Drift gill net (GN) is the major gear employed in the fishery all along the Indian coast, while purseseines and hooks and lines also contributed significantly along the southwest coast.
- Along the northwest coast *T. tonggol* (76%) and towards south *T. albacares* and *K. pelamis* contributed 55% and coastal tuna *E. affinis* 31% of the total tuna catch. Juveniles of *T. albacares* constituted nearly 33% at Tuticorin.
- Multiday drift gillnet fishing in distant waters has been responsible for increase in landings of skipjack and yellowfin at Cochin.
- Except in the case of oceanic tunas, the coastal species were exploited optimally from the presently fished grounds.
- Pole and line fishermen from the Islands are facing constraints in the availability of fuel, ice and live baits. Recently some attempts have been made to introduce artificial baits and during 2003 about 8% of the pole and line units were fishing without using any live baits thereby easing the pressure on livebait stocks also.
- It has been observed that large yellowfin tuna weighing 15-30 kg form bulk of hand line tuna catches (at 100-150 m depths) in Lakshadweep seas. If regularly and properly operated, troll line fishing can greatly enhance the tuna catches.
- At Minicoy, although skipjack tuna accounted for 79% of the tuna catch, compared to previous year it showed a decline by 14% while *T. albacares* increased from 7% to 20%. This was due to adoption of pole and line fishing around FADs when yellowfin juveniles were also caught.
- Although fishing for tunas around data buoys functioning as Fish Aggregating Devices (FADs) is favoured by fishermen of Minicoy who are venturing into these fishing grounds using GPS, the large scale harvest of juvenile tunas may not be beneficial in the long run.
- The livebait fishery was characterised by the reappearance of *Chromis* sp., which was absent for many years. Livebaits caught from lagoons and the open sea during the season were sprats (59%), caesionids (22%) and apogonids (12%).

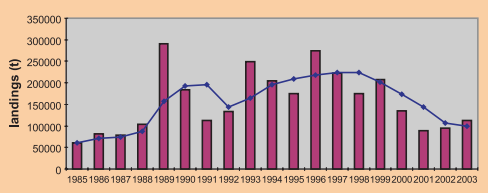


Gearwise landings of tunas in India

- Troll line fishing was initiated at Colachel by deep sea shrimp trawlers (45-60 m OAL) as an additional fishing effort which yielded encouraging catches of large yellowfin tuna weighing 30-80 kg and catch per unit per boat ranging between 1-5 tonnes. Although initially started as an incidental fishery during 2000, in 2003 it led to targeted fishing for yellowfin tuna (300-500 m depths) and proved profitable.
- Good aggregation of juvenile tunas were reported around Data Buoys of the National Institute of Ocean Technology (NIOT) deployed 16-26 nautical miles off Minicoy for Arabian sea Monsoon Experiments which led to increased exploitation of tunas from these grounds by pole and line fishermen.

Tuna eyes: Tuna eyes are an item of commerce. Its demand is attributed particularly to its content of polyunsaturated fatty acids like decosahexaenoic acid valued for its medicinal properties in combating atherosclerotic and thrombotic problems of chronic heart patients and also for its reported anticarcinogenic and brain developing properties. Extraction and preservation of eyes of tuna and its marketing have good prospects.

PROJECT CODE	**PEL/CAP/5**
PROJECT TITLE	**Development of management strategies and options for sustainable harvest of mackerels**
SCIENTISTS	**G.Gopakumar,** Mohammad Zafar Khan, Prathibha Rohit, M.Sivadas, P.N.Radhakrishnan Nair, N.G.K. Pillai, E.M. Abdussamad, H.Mohamad Kasim and A.K.V. Nasser
CENTRES	Mumbai, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Mandapam, Tuticorin, Chennai, and Visakhapatnam



Trend of all India mackerel landings 1985-2003

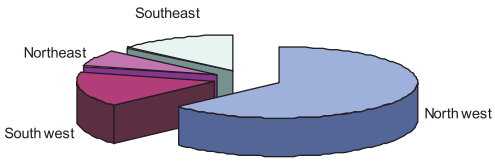
- The estimated mackerel landing during 2003 was 1.12 lakh t which showed a marginal increase by 18 % compared to 2002.
- One of the objectives of the project was to investigate the effectiveness of different types of gears for the exploitation of mackerel resource. Gill net, purseseine, trawl net and ringseine were the major gears employed for the exploitation of mackerel along the Indian coasts. The contribution of gill net to the mackerel catch was 74% at Vizhinjam, 29.4% at Cochin, 0.3% at Mangalore, 5.6% at Tuticorin, 96.2% at Mandapam, 27% at Chennai and 56.5% at Visakhapatnam. Purseseine contributed 71.8% and 25.2% respectively at Mangalore and Mumbai. Trawl net contributed 74.8% of mackerel catch at Mumbai, 27.9% at Mangalore, 35.5% at Calicut, 70.6% at Cochin, 94.4% at Tuticorin, 3.8% at Mandapam, 24% at Chennai and 43.5% at Visakhapatnam. Ringseine contributed 64.5% of the mackerel catch at Calicut.
- In the gill nets the size ranged from 105-305 mm. There was an increase in the modal size from Mangalore to Vizhinjam in the south. Along the east coast it was *vice versa*.
- In trawl net, mackerel catch ranged in total length from 55-295mm. The major modes noted were 185, 215 and 245mm at Mumbai, 200mm at Mangalore, 75, 120, 170 and 200mm at Calicut, 195 and 230mm at Cochin, 232mm at Chennai and 185mm and 215mm at Visakhapatnam. In ringseine mackerel ranged in total length from 140 to 275mm with modes at 165, 190 and 220mm.
- Exploitation rates during the year were found to be optimum at Centres like Visakhapatnam , Tuticorin , Cochin and Mangalore.

PROJECT CODE	**PEL/CAP/6**
PROJECT TITLE	**Development of management strategies for sustainable fishery of Bombayduck**
SCIENTISTS	**Alexander Kurien**
CENTRES	Mumbai, Veraval and Kakinada

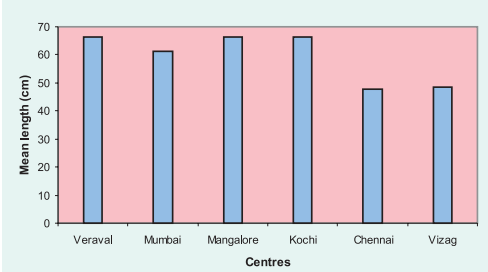
- Bombayduck landings during 2003 were estimated at 1.3 lakh t showing an increase of 7% compared to previous year. The resource was exploited by trawl nets and *dol* nets. The current exploitable stock is around 87,000 t.
- Large scale landings of indeterminate and immature fishes have been a source of concern. Mesh size regulation appeared difficult during the peak abundance of Bombay duck as the fishing ground is an assemblage of mixed populations of different sizes of finfishes and shellfishes. Effort regulation could be the alternative choice.

PROJECT CODE	**PEL/CAP/7**
PROJECT TITLE	**Monitoring of fishery and resource characteristics of exploited ribbonfish stocks and their management along the Indian coast**
SCIENTISTS	**P.N.Radhakrishnan Nair,** Mohammad Zafar Khan, C. Muthiah, A.A. Jayaprakash, H. Mohamad Kasim and A.K.V.Nasser
CENTRES	Veraval, Mumbai, Mangalore, Cochin, Vizhinjam, Chennai, Kakinada and Visakhapatnam

- The estimated ribbonfish landing in India during 2003 was 1.8 lakh t. The fishery declined in 2003 by 7% over 2002. But compared to the average annual landings for the period 1998-02, 15% increase was noticed during the current year in all the maritime states, except Kerala.
- Trawl is the major gear in the fishery all along the coast of India, which contributed 95% of the catch. A reduction in number of trawl units was noticed only at Cochin (33.8%) and Chennai (36.2%). In other Centres it increased by 1.5% at Mangalore-Malpe, 2.6% at Visakhapatnam, 7.5% at Veraval and 12.6% at Mumbai.
- The ribbonfish landings at these centres decreased by 14.9% in 2003-04 compared to 2002-03. The landings in trawl decreased considerably in all the centers except at Mangalore-Malpe. The peak fishery was during the quarter October to December, when 62% of the catch was landed. The peak production was in November along both the coasts.
- The percentage of ribbonfish in the total trawl landings was much less in 2003-04 and it formed nearly 9.3% against 12.4% in 2002-03. The catch rate also decreased by 7.7%. The catch rate in trawl net ranged from a minimum of 26.2kg at Cochin to a maximum of 273.9 kg at Visakhapatnam. It was 249kg at Mumbai and 246kg at Veraval.
- *Trichiurus lepturus* was the dominant species reported from all the centers. The 1+ year old fish (50-77cm) dominated in the catch in most of the centers except at Chennai and Visakhapatnam where 0-year class (<50cm) was predominant. The mean length of the catch in trawl landings along the west coast was higher when compared to the east coast fishery. The minimum size of recruitment was 18cm in trawl, 18cm in boat seine (Visakhapatnam) and 58cm in gill net (Veraval).
- Studies on the stock structure of *T. lepturus* indicated that the stock had slightly declined. The exploitation rate ranged from 0.63 (Mumbai) to 0.77 (Mangalore) indicating that the resource is under increased fishing pressure. Along with the decrease in production a declining trend in the mean length was also noticed in most of the centers, especially along the east coast. The catch rate also decreased in trawl fishery. Mostly young fish belonging to 0-year and 1+ year classes formed the main stay of the fishery and the proportion of older fish was much less. All these were indications of over exploitation. So a reduction in fishing pressure is recommended.



Regionwise contribution to ribbonfish landings - 2003



Mean length of *Trichiurus lepturus* in trawl landings from different centres - 2003-2004

PROJECT CODE	**PEL/CAP/8**
PROJECT TITLE	**Management of carangid resources of Indian EEZ**
SCIENTISTS	**H. Mohamad Kasim,** Prathibha Rohit, A.A.Jayaprakash, E.M. Abdussamad and A.K.V. Nasser
CENTRES	Veraval, Mangalore, Cochin, Tuticorin and Visakhapatnam

- The all India carangid production during 2003 was 1.22 lakh t showing 2.5% decline compared to the previous year.
- Along the west coast the trawls landed 77.1 and 69.5% of the total carangid catch respectively at Veraval and Mangalore. The second dominant gear was gill nets at Veraval contributing 32.9% and at Mangalore it was purse seine contributing 28.8%. Along the east coast also the trawls landed 88.7 and 96.8% at Tuticorin and Visakhapatnam respectively.
- Several species supported the carangid fishery. *Megalaspis cordyla* dominated the gill net landings at Mangalore and second dominant species in trawl landings. *Decapterus russelli* was the dominant species in trawl and purse seine landings at Mangalore and in trawl landings at Cochin. *Caranx sexfasciatus* was the dominant species in *Paruvalai* and hooks & line at Tuticorin. Whereas, in *Podivalai Caranx carangus* was the dominant species and in trawl landings *Selar crumenophthalmus* was the dominant species. At Visakhapatnam *S. crumenophthalmus* was the dominant species followed by *M.cordyla* in bottom set gill net landings.
- At Mangalore the size of *D. russelli* ranged from 50-235mm with more than one dominant mode in trawl landings and in the purse seine landings the size of this species varied from 80-225 mm with different modes. The size range of *M. cordyla* varied from 90-405mm in trawl landings with different modes, in the drift gillnet landings the size varied from 160-500 mm with multimodes. At Tuticorin, the size of *Selaroides leptolepis* varied from 80-214 mm with a mean at 134mm in trawl landings. The size of *C. sexfasciatus* ranged from 40-113 cm with a mean of 82.2 cm and several modes. The size of the *S. crumenophthalmus* from trawl net catches at Visakhapatnam varied from 140-260 mm with a dominant mode at 175-179 mm.
- Based on the growth parameters, gearwise catch, MSY and exploitation rates obtained for different species along Kerala coast, it is inferred that *M. cordyla* is exposed to higher fishing pressure by both gillnet and trawl and *D. ruselli* by trawl, as the present yield of these two species by these two gears are lower on the descending limb of the yield curve than the MSY and the exploitation rates are also higher than the E_{opt} of the respective species. Whereas, *S. crumenophthalmus* is underfished by both trawl and gillnets as the present catch is lower on the ascending limb of the yield curve than the MSY and the exploitation rates are also lower than the E_{opt} of the species.

PROJECT CODE	**PEL/BIOD/01**
PROJECT TITLE	**Taxonomy of marine pelagic finfishes**
SCIENTISTS	**Prathibha Rohit,** A.A.Jayaprakash, P.N.Radhakrishnan Nair, U.Ganga, E.M. Abdussamad and A.K.V. Nasser
CENTRES	Mangalore, Cochin, Tuticorin and Visakhapatnam

- Detailed cataloguing and inventory of seventy two species of pelagic finfishes belonging to seven families and thirty nine genera were completed during the year.
- The genera covered under Clupeidae family were *Escualosa, Sardinella, Nematolosa, Anodontostoma, Pellona, Ilisha, Opisthopterus, Dussumieria* and *Hilsa* and under Engraulidae family, four genera – *Encrasicholina, Stolephorus, Thryssa* and *Coilia*.
- Carangids belonging to seventeen genera namely, *Seriolina, Decapterus, Megalaspis, Selar, Alectis, Ulua, Uraspis, Atropus, Selaroides, Gnathanodon, Atule, Alepes, Caranx, Carangoides, Elagatis, Trachinotus* and *Scomberoides* were studied. The genera under Scombroids included *Auxis, Euthynnus, Thunnus, Scomberomorus* and *Rastrelliger.*

DEMERSAL FISHERIES DIVISION

Resource characteristics of demersal fish groups were studied by the Demersal Fisheries Division through 6 capture fisheries projects. Data on biodiversity of 5 families were collected from different regions. Successful breeding of 2 species of marine ornamental fish *Dascyllus aruanus* and *D. trimaculatus* was achieved.

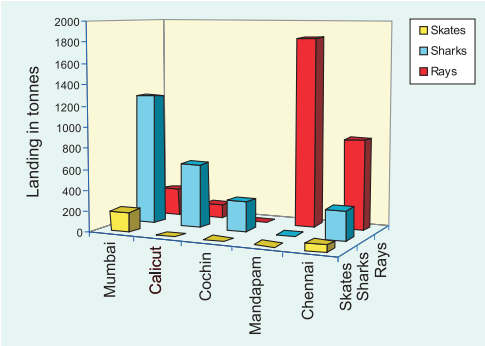
The Scientists of the Division implemented 3 sponsored projects. Significant results were obtained on the negative impact of bottom trawling on macro and meio benthos.

The Division had also filed a patent for the Brood Stock Development of Groupers.

PROJECT CODE **DEM/ CAP/01**

PROJECT TITLE **Fishery and biological characteristics of the exploited stocks of Elasmobranchs**

SCIENTISTS **S. G.Raje,** G. Mohanraj, A. Raju , K. K.Joshi, P. P. Manojkumar.



Landing (t) of sharks, skates and rays at different centres during 2003

Significant findings

The All India Elasmobranchs landings contributed to 2.19% of the total marine landings during 2003 indicating a marginal decline by 2.37% when compared to that of 2002.

East coast contributed to 50.65% of elasmobranchs landing with west coast contributing to 49.35%.

While sharks and skates showed a decline in landings, rays registered an increase by 28.5%.

State-wise, Gujarat and Maharashtra brought good landings of sharks while the bulk of rays was from Tamil Nadu and Andhra Pradesh .

A total of 30 species of sharks, 24 species of rays and 7 species of guitar fishes contributed to the fishery.

The major gears to land elasmobranchs were trawl, gill nets and hooks & line.

Rare landings of Snaggle tooth Shark (Hemipristis elongatus) was noticed at Beypore, Calicut from 130 m depth.

The Elasmobranchs Fishery had an estimated annual landings of 58387 t contributing to 2.19% in the total marine landings during the year 2003. The fishery was represented by sharks (52.5%), skates (4.28%) and rays (43.18%).

During 2002, the All India elasmobranchs landing was 59808 t thus registering a decline by 2.37% this year. Groupwise, sharks and skates indicated a decline, whereas rays showed an increase in landings from 19619 t of 2002 to 25214 t during 2003 (5595 t; 28.5%). Region wise, while Gujarat and Maharashtra contributed to 56.35% of all India shark landings, Tamil Nadu and Andhra Pradesh contributed to 76.6% of the rays landed in the country.The east coast contributed to 50.65% of elasmobranchs landing while the west coast contributed to the rest.

Centrewise, Mandapam brought the maximum landings, the entire catch represented by rays. The next abundant landing was realized off Mumbai which was dominated by sharks followed by rays and skates. Rays formed 72% of the elasmobranchs landed in Chennai while in Calicut and Cochin, sharks were the major contributors to elasmobranch fishery. Sharks were landed more in trawl off Mumbai and Chennai , in gill net off Cochin and in hooks & line off Calicut.

A total of 30 species of sharks, 24 species of rays and 7 species of guitar fishes were represented in the fishery at various centres. The dominant species of sharks landed were *Scoliodon laticaudus* at Mumbai,*Carcharhinus limbatus* and *C.sorrah* at Calicut and C.*melanopterus* and *Rhizoprionodon acutus* at Cochin. Among rays, the dominant species landed were *Dasyatis zugei* at Mumbai , *D. jenkinsi* at Chennai and *Himantura Spp.*at Mandapam. *Rhynchobatus djiddensis* was the major species of guitar fish landed off Mumbai. Rare landings of Snaggle tooth Shark(*Hemipristis elongatus)* was noticed at Beypore, Calicut from 130m depth.In Calicut, *C. limbatus* (T.L.552-2502mm) and *Sphyrna zygaena* (1782-2528mm) caught in longline were of larger size than those caught in trawl (702- 1248mm and 302-1418mm, respectively) . Sex ratio studies showed that females of rays which grow to a larger size than males dominated the population with differential growth discernible during the gestation period itself.

PROJECT CODE	**DEM/CAP/02**
PROJECT TITLE	**Fishery and biological characteristics of exploited resources of Groupers and Catfishes**
SCIENTISTS	**N.G.Menon,** Grace Mathew, K. V.Somasekharan Nair , Paramita Banerji

Groupers

The All India landings of groupers during 2003 was 15222 t which indicated a steep decline by 40.4% when compared to the landings during 2002 (25539 t). Major contributing states to the grouper landings were Kerala (5272 t), Tamil Nadu (3681 t) and Maharashtra (2969 t) .

Maximum landings of 997 t was landed off Tuticorin contributed by trawl net (745 t ; 74.78%) and hooks & line (250.8 t ; 25.22%). Mumbai landed a total of 553.3 t of groupers, the major gear being trawl. The landing of groupers at Cochin was 119 t, which was brought by trawl (44 t) and hooks & line (75 t). *Epinephelus diacanthus* contributed to 99.5% of the grouper landings in trawl, while in hooks & line, *E. diacanthus* (31.38%), *E. chlorostigma* (27.74%), *Cephalopholis Spp.*(27.2%), *Epinephelus bleekeri* (7.75%) and *E. tauvina* (5.91%) were the species landed The catch of *E. diacanthus* off Cochin in trawl consisted of juveniles and immature fishes(16 – 34cm)with larger specimens(30-48cm) caught in hooks & line. In Tuticorin, groupers were landed more during June – August and during February- March in trawl and during October- December months in hooks & line. In Mumbai, the peak landing was during September- December period.

Size range of groupers landed by different gears at various centres

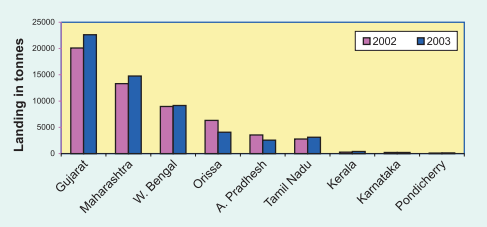
Centres	Gear	Species composition (%)	Length range(T.L.)(cm)
Cochin ,,	Trawl	*E.diacanthus* (99.5)	16 – 34
	Hooks & Line	*E.diacanthus* (31.4)	30 - 48
	,,	*E.chlorostigma*(27.7)	28 – 58
		Cephalopholis Spp.(28)	- -
		E. tauvina(6)	55 – 69
Tuticorin	Trawl	*E. undulosus*(42)	22 – 73
		E. malabaricus(35)	46 – 112
		E.tauvina(15)	——
	Hooks & Line	*E. malabaricus*(52)	30 – 114
Mumbai	Trawl	*E. diacanthus*(86)	12 – 40

Catfishes

All India Catfish landing during 2003 amounted to 56434 t, which contributed to 2.12% of the total marine landings. The catch was more on the north west coast, which increased during 2002 -2003 period .

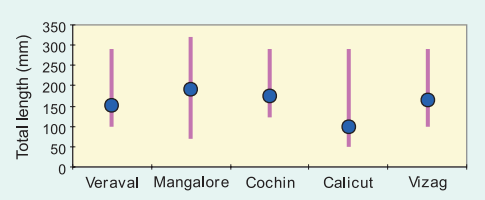
Catfish landing was monitored at Cochin and Mumbai and good landing was realized off Mumbai (1161 t) in trawl. In Cochin, the catch was very low (9.423 t).

The major species landed at Mumbai were *Tachysurus dussumieri* (17 – 77.9 cm), *T. caelatus* (16-48 cm) and *Osteogeniosus militaris* (13-47 cm) off Mumbai and *T. thalassinus* (45- 55 cm) and *T. tenuispinis* (50-55 cm) off Cochin.

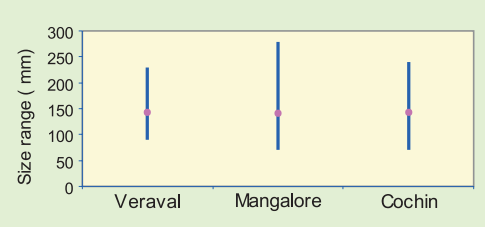


Statewise landings of catfishes during 2002 and 2003

PROJECT CODE DEM/CAP/03
PROJECT TITLE Characteristics of exploited stocks of Threadfin breams and Silverbellies
SCIENTISTS **P.U.Zacharia,** S.Sivakami, E.Vivekanandan,K.V.Somasekharan Nair, A.Raju, U.Rajkumar, P.P.Manojkumar



Size range (mm) and mean size of *N. japonicus* landed at various centres



Size range (mm) and mean size of *N. mesoprion* landed at various centres

Threadfin breams

The estimated landing of Threadfin breams in India during 2003 was 106357 t, which was lower by 3.65% when compared to that of 2002.

State wise, the major contributors were Maharashtra (27360 t), Kerala (23163 t), Gujarat (22250 t) and Karnataka (21930t) the west coast contributing to 89% of the total nemipterid landings of the country.

Centre wise, maximum production is reported from Malpe (11614 t), and Mangalore (10224 t) followed by Veraval (7451 t), Calicut (6971 t), Visakhapatnam (1749 t) and Cochin (548 t).

The mean size of *N. japonicus*_landed off Mangalore (192 mm) and Cochin (174.6 mm) was higher than those caught at Veraval (152.48mm), Visakhapatnam (165.5mm) and at Calicut (100.4mm). The mean size of *N.mesoprion* was 143.5 mm at Veraval, 142 mm at Mangalore and at 143 mm off Cochin.

Studies on growth, mortality and exploitation level of threadfin breams indicate that *N. japonicus* is exploited above optimum level off Mangalore (E. = 0.66), Veraval (E=.0.68) and off Visakhapatnam (E=0.65). In *N. mesoprion*, exploitation rate at Mangalore and Cochin is 0.69 and 0.72, respectively.

Growth, mortality and exploitation level of threadfin breams and silverbellies from different centres

Species	Centre	L∞	K	Z	M	F	E	Status
N.japonicus	Mangalore	328	0.98	5.24	1.74	3.5	0.66	Above
	Veraval	323	1.0	5.6	1.77	3.83	0.68	Optimum
	Vishakapatnam	310	1.21	6.11	2.02	4.09	0.65	level
N.mesoprion	Mangalore	286	1.01	6.07	1.85	4.22	0.69	-do-
	Cochin	285	0.88	6.2	1.69	4.51	0.72	-do-
L.dussumieri	Pamban	158	1.71	3.01	1.94	1.07	0.35	Under-exploited

All India Threadfin breams landings during 2003 was 10635 t; the west coast contributing to 89% of the catch.

N. mesoprion was the dominant species at all centres (pooled).

N. japonicus was found exploited above optimum level at Mangalore, Veraval and at Visakhapatnam.

Silverbellies were represented by 9 species at Mandapam and the dominant species- L. dussumieri has not reached the optimum level of exploitation.

Silver bellies

The All India Silver bellies landings during 2003 amounted to 52448 t, which indicated a decline by 15.5% when compared to that of 2002.Tamil Nadu contributed to the maximum of 30060t (57.3%). Centre wise, landings of silverbellies from Mandapam, Rameswaram and Pamban together amounted to 9249 t .

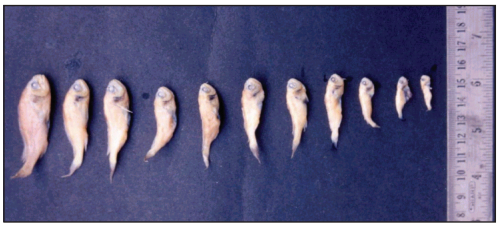
Fishery off Mandapam was contributed by 9 species of which *Leiognathus brevirostris* and *L. dussumieri* dominated. The size range of *L. brevirostris* and *L. dussumieri* were 35-145 mm and 40-140 mm, respectively.The growth and mortality parameters and level of exploitation of silverbellies show that *L. dussumieri* is under exploited off Pamban.

PROJECT CODE DEM/CAP/04
PROJECT TITLE **Fishery and biological characteristics of exploited stocks of Croakers**
SCIENTISTS **G.Mohanraj,** K.V.S .Nair, Paramitha Banerji

The estimated landing of croakers in India during 2003 was 125,270 t, which showed a marginal increase by 1.52% when compared to that of 2002. Gujarat and Maharashtra together contributed to 53.8% (67418 t) of the total sciaenid landings in the country.

Resource characteristics of sciaenids monitored from Veraval, Mumbai, Chennai and Kakinada revealed that the catch was good at Mumbai (8860 t) followed by Veraval (3884 t).

The major gear used was trawl though gillnets at Veraval and Kakinada and dol net at Nawabunder and Veraval also landed sciaenids. The landing of Sciaenids in gill net was 151 t Veraval and 98 t at Kakinada. In Veraval, the sciaenid landings in dol net amounted to 884 t.



Sciaenid juveniles landed at Kakinada

The sciaenids were represented by 18 species off Chennai, 17 at Kakinada, 12 at Mumbai and 7 species at Veraval. The dominant species in the sciaenid fishery was *Otolithus cuvieri* at Veraval, *O. ruber* at Chennai, *Otolithoides biauritus* at Mumbai and *Atrobucca nibe* at Kakinada.

An important observation is the capture of juveniles of Ghol (*Protonibea diacanthus*) and Koth (*O.biauritus*) in large quantities at Mumbai during October-December 2003. The minimum size obtained in Ghol is 129.5mm (total length) and in Koth it is 189.5mm. The percentage of juveniles and subadults obtained in *O.biauritus* and *P. diacanthus* were found to be 97.7 % and 96.6 %, respectively. Likewise, sciaenid fishery at Kakinada over the years indicated a decline in landings probably caused by their juvenile capture by shrimp trawlers.

The All India sciaenid landings indicated an increase by 1.52% during 2003.

A total of 18 species were represented in the landings.

A decline in the sciaenid landings at Kakinada over the years is probably caused by the exploitation of juvenile sciaenids by shrimp trawlers.

Capture of juvenile Ghol and Koth in trawl is reported from Mumbai.

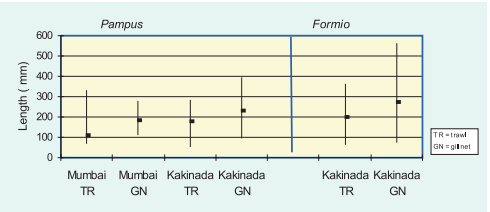
PROJECT CODE DEM/CAP/05
PROJECT TITLE **Biology and stock assessment of Lizard fishes, Bulls eye and Pomfret resources**
SCIENTISTS **S.Sivakami,** S.G.Raje, E. Vivekanandan, Rekha.J.Nair, U.Rajkumar

The All India Lizardfish landings during 2003 was 29018 t with Kerala contributing to the maximum of 10686 t (36.8 %). The resource was monitored from Veraval, Mumbai and Cochin along the west coast and at Chennai and Kakinada along the east coast. Of all the centres, Veraval brought the maximum landings of 3151t followed by Chennai (1079 t), Mumbai (666 t), Kakinada (543 t) and Cochin (516 t).

Specieswise, *Saurida tumbil* was dominant along the north west coast and *S. undosquamis* along the South west coast & south east coast.Other species represented were *S. micropectoralis, S. longimanus, S. isarankurai, Trachinocephalus myops, and Synodus englemani.*

Peak landings of lizardfishes were observed during September at Veraval, October/November at Mumbai, March and June to September at Cochin and June to August at Chennai and Kakinada.

Lower mean size of *S. undosquamis* was found (175 mm) at Chennai with juveniles and sub adults contributing to 42.6 % (by wt) of the lizard fish landings thus indicating growth overfishing in the species at Chennai.



Size range (mm) and mean size of *Pampus argenteus* and *Formio niger* landed at various centres

Exploitation rate of *S.undosquamis* at Vishakapatnam is 0.58, which is more than the E max of 0.48. The optimum yield can be maintained by reducing the Exploitation rate up to 0.3. The high E rate may be detrimental to the resource off Vishakhapatnam.

Bull's eye landings was low, ranging between 21 t at Chennai and 348 t at Veraval.

Priacanthus hamrur, the only species represented had a size range of 120-270 mm at Veraval, 130-330 mm at Mumbai and 110-360 mm at Cochin.

Pomfret landing on an All India level during 2003 was 40011 t contributed by *Pampus argenteus* (22646 t), *Formio niger* (15404 t) and *P. chinensis* (1961 t).

Maximum landing of pomfrets (1621t) was from Mumbai, the major gears being trawl (367 t), gill net (283 t) and dol net (971 t).

P. argenteus landed in gill net had a higher mean size both at Mumbai (186.83mm) and Kakinada (229 mm) when compared to that caught in trawl at Mumbai (112.3 mm) and at Kakinada (179 mm). In *F. niger* also, a similar trend is observed.

The all India lizardfish landing during 2003 was 29018 t with Kerala contributing to the maximum. S.tumbil and S. undosquamis were the major species represented.

In Chennai, with 42.6% of the landings contributed by juveniles and sub adults and with a comparatively low mean size of 175mm, the lizardfish fishery was found to be under fishing pressure. In Visakhapatnam, S.undosquamis is over exploited.

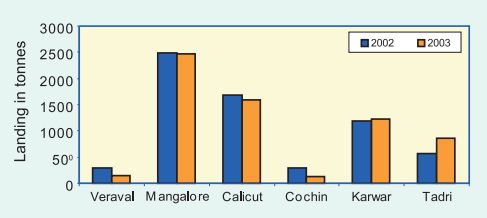
PROJECT CODE **DEM/CAP/06**

PROJECT TITLE **Biology and Fishery of Flatfishes and Goatfishes**

SCIENTISTS **K.V.Somasekharan Nair,** P.U.Zacharia, P.P.Manojkumar, E.Vivekanandan, Rekha.J.Nair, U.Rajkumar

Flat fishes

The All India landing of flat fishes amounted to 47612 t during 2003 forming 1.8% of the total fish production. The major contributors were Soles (46347 t), Flounders (64 t) and Halibut (1201 t).



Landings of flatfishes at different centres during 2002 and 2003

Centre-wise, during 2003, the flatfish landing was the maximum off Mangalore (2474 t) followed by Calicut (1596 t), the catch declining by 0.32 % to 5.5% compared to that of 2002. At Karwar, the catch (1234 t) showed an increase by 3.4 % when compared to that of 2002. Flat fish landing at Veraval and Cochin was low (137 t each).

Peak landing was during October – December off Mangalore and Veraval and during December- April and August- September along the southwest coast.

Of the 10 species landed at various centres, *Cynoglossus macrostomus* formed above 90% at all the centres studied. Other species represented were *C. bilineatus, C. dubius, C. arel, Psettodus erumei* and *Bothus panthei.*

In Cochin, young recruits of *C. macrostomus* was landed during December- March period with spawning season during August- September months.

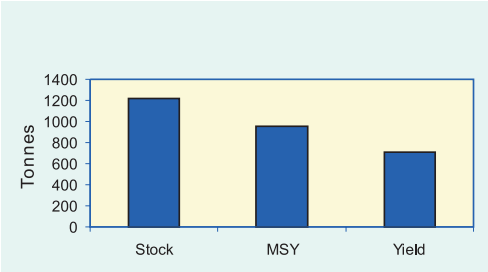
Stock assessment studies of *C. macrostomus* made off Calicut revealed a bimodal peak of recruitment during May- June and October- November months**.** The exploitation rate of the species was 0. 68, with an E max of 0.80, indicating that the species is under -exploited .

Goatfishes

An estimated 11007 t of goatfishes were landed during 2003 with east coast contributing to 92%.Andhra Pradesh (4758t) and Tamil Nadu (4423t) were the major contributors. Centre-wise, a total of 3262 t of goatfish were landed at Visakhapatnam during the report period followed by Chennai (706 t).

Upeneus taeniopterus was the dominant species landed off Chennai and *U. vittatus* off Vishakapatnam. Peak season of goatfish landing off Visakhapatnam was July and November.

At Chennai, the VBGF parameters of *U.taeniopterus* are K = 0.845, Lα= 263 mm and to = -0.148y. Exploitation rate of the species is 0.578. The stocks are estimated as 1215 t, with MSY of 952 t and yield 711 t indicating scope for further exploitation.

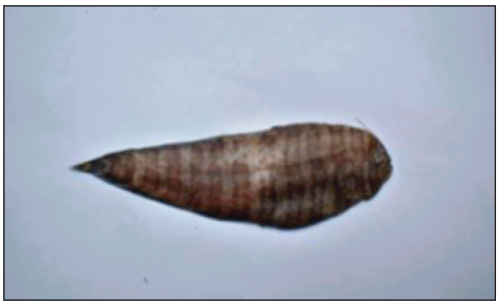


Exploitation of *Upeneus taeniopterus* off Chennai

PROJECT CODE DEM/BIO/01
PROJECT TITLE **Taxonomy of demersal fishes of India**
SCIENTISTS **K. K.Joshi,** P.U.Zacharia, G.Mohanraj, .P.P.Manojkumar, Rekha.J.Nair, U.Rajkumar.

Data on the morphometric and meristic characters of various species belonging to the families of Nemipteridae (5 species), Cynoglossidae (6 species), Soleidae (1),Sciaenidae (18 species) and Mullidae (5 species) were generated from centres such as Veraval, Mangalore, Calicut and Cochin along the west coast and from Chennai and Vishakhapatnam along the east coast.

A new record, *Aesopia cornuta (Family: Soleidae)* was reported from Calicut. Ten specimens measured had a total length range of 109-160mm and were distinguishable from other similar species by the thickened first free ray of the dorsal fin, the brownish body colour with 14-16 bands edged with black and with some pale spots.



Aesopia cornuta (Flat fish) a new record

PROJECT CODE DEM/CUL/01
PROJECT TITLE **Marine Finfish culture**
SCIENTISTS **L.Krishnan,** D.C.V.Easterson , A. Raju, G. Gopakumar, Molly Varghese, D.Noble, K.S.Shobana

Groupers:

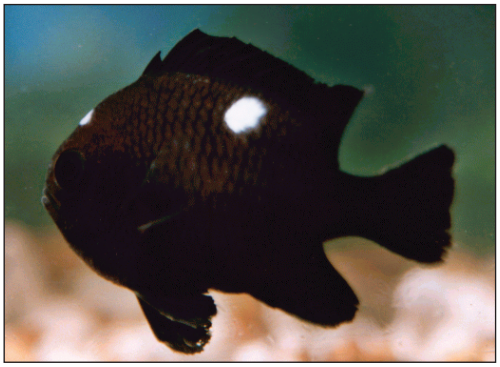
- Brood stock development of groupers was carried out at Mandapam, Tuticorin and Cochin. Maturation process was monitored regularly. However no spawning was observed.
- Special efforts were made at Cochin to maintain super small rotifer – *Brachionus rotundiformis* brought from Andamans. Also maintained cultures of herpacticoid copepod *Euterpina acutifrons* at high densities in recirculatory seawater of 30 ppt salinity at Cochin.

Dascyllus aruanus adult

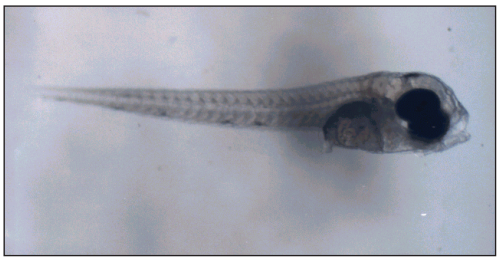
Ornamental fishes

Breeding of 2 species of damsel fishes viz. the three spot damsel fish *Dascyllus trimaculatus* and the humbug damsel *D. aruanus* was achieved at Vizhinjam.

- The eggs of both the species are capsule shaped and the clutch size



Dascyllus trimaculatus adult



Newly hatched larva of *D.trimaculatus*

was high in *D. trimaculatus* ranging from 12000 – 15000 eggs when compared to that of *D. aruanus* (1000 – 2000).

- The average length of the newly hatched larvae was 2.5 mm in *D. trimaculatus* and 2.4 mm in *D. aruanus*. Parental care by males was noticed in both the species.

Broodstock of groupers maintained in outdoor and indoor tanks at Mandapam.

Successful spawning was achieved in 2 species of marine aquarium fishes namely Dascyllus trimaculatus and D. aruanus. Males of both the species exhibit parental care.

CRUSTACEAN FISHERIES DIVISION

The Crustacean Fisheries Division implemented 7 in-house and 5 funded projects during 2003-04. The resources data and biological parameters of commercially important penaeid and non-penaeid shrimps, lobsters and crabs collected from the mechanised and artisanal fish landing centres along the Indian coast were analysed and management measures for sustainable exploitation of the resources were suggested. Seed production and ranching of the green tiger shrimp *Penaeus semisulcatus* in Palk Bay were continued. A significant achievement has been implementation of a recommendation by the CMFRI on Minimum Legal Size regulation for export of lobsters by the Ministry of Commerce and Industry, Government of India. Under the MPEDA funded project on 'Participatory management and conservation of lobster resources along the southwest coast of India' four workshops were held in Maharashtra and Gujarat on Conservation of lobster resources. The Scientists were involved actively in the PGPM programme and two Ph.D students supervised by the Division Scientists were awarded Ph.D by CIFE. The Scientists of the Division participated in the International training programme and also attended International Conference and presented research papers.

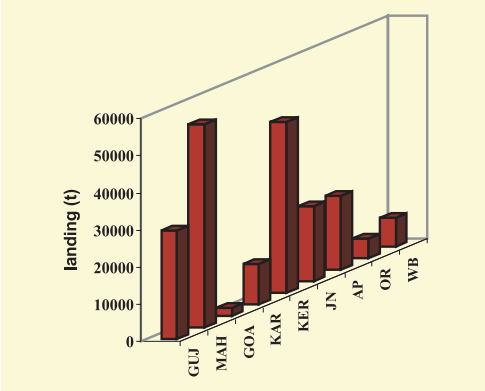
Significant achievements

- A major breakthrough was achieved in the breeding and hatchery production of the commercially important slipper lobster *Thenus orientalis*. This achievement is a milestone in developing commercially viable hatchery technology for the lobsters and is expected to promote farming of the slipper lobster in India. The larvae of another Scyllarid lobster has also been reared to settlement.
- Successful breeding and hatchery production of the ornamental Doctor shrimp *Stenopus hispidous* has also been a remarkable achievement during this year.

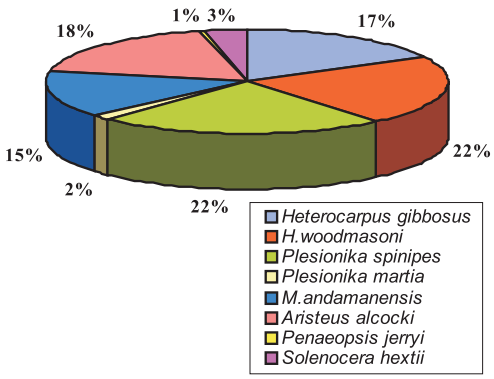
- *The estimated landing of crustacean resources (shrimps, lobsters, crabs and stomatopods) is 4,32,246 t which accounted of 17 % of the total marine fish production in India.*
- *The crustacean landings improved over the previous year by 4,387 t.*
- *Penaeid shrimps formed 49.6 % of the total crustacean landings followed by non-penaeid prawns (31.7 %), lobsters (0.3 %), crabs (9.8 %) and stomatopods (8.6 %).*

PROJECT CODE	**CRU/CAP/01**
PROJECT TITLE	**Investigations on the fishery and biological characteristics of exploited penaeid shrimp stocks**
SCIENTISTS	**G.Nandakumar,** Josileen Jose, P.T.Sarada, A.P.Dineshbabu, V.S. Kakati, V.D.Deshmukh, Joe K. Kizhakudan, M. Rajamani, K. R. Manmadhan Nair, K. Asokakumaran Unnithan, G.Maheswarudu, and K.N.Saleela.
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Neendakara, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam.

- The estimated shrimp landings by trawlers at Veraval (Gujarat) and New Ferry Wharf (Maharashtra) during April 2003 – March '04 was 1604 t and 15940 t with catch rate of 0.6 kg and 9.3 kg/hour respectively. *Parapenaeopsis stylifera*, *Solenocera crassicornis* and *Metapenaeus affinis* were the major contributors to the shrimp fishery. Size range of *S. crassicornis* was 51-140 mm along northwest coast and the peak breeding season was January-February at Veraval and October in Mumbai.
- At Karwar and Tadri in North Karnataka, *P. stylifera*, *M. dobsoni* and *M. affinis* were the main species observed in the penaeid landing which was 501 t and 485 t with catch rate of 6.92 and 6.77 kg respectively.



Estimated average Penaeid prawn landing in India during 1999-2000 to 2003-2004



Species composition of deep sea shrimp fishery along Kerala coast

- The estimated shrimp landing at Mangalore-Malpe was 3009 t with CPH of 1.5 kg which was a decline of 40% in catch and 46% in catch rate from the previous year. The fishery was mainly contributed by *S. choprai* (38%), *M. monoceros* (31%), *M. dobsoni* (14%), *P. stylifera* (10%) and *F. indicus* (13%). Size range of *S. choprai* and *M. monoceros* was 46-110 mm and 81-145 mm respectively. The peak breeding season was October-February for *S. choprai*.
- The penaeid shrimp catch at Calicut amounted to 575 t with catch rate of 44.5 kg/unit. Unlike the earlier years, the percentage contribution of *F.indicus* in shrimp catch went up to 40% due to heavy landings during April-May and the other species observed in the fishery were *M. dobsoni* (31%) and *P. stylifera* (15%). Size range of *F. indicus* was 71-180 mm and the peak breeding month was March '04.
- The estimated penaeid shrimp catch and catch rate at Cochin and Sakthikulangara were 5467 t and 9.6 kg; and 6116 t and 7.1 kg respectively. *P. stylifera* and *M. dobsoni* were the two main constituents of the shrimp fishery in these centres.
- Size range of *P. stylifera* and *M. dobsoni* along the west coast was 41-145 mm and 46-125 mm respectively. Premonsoon period was the main breeding season for these species.
- Along Southeast coast at Tuticorin and Rameswaram *P. semisulcatus* (size range 81-180 mm) was the dominant species of penaeid shrimp fishery. The penaeid shrimp landings at Kasimedu (Chennai) was 2048 t and the important species which constituted the fishery were *M. dobsoni, F. indicus, P. maxillipedo, M. stridulans* and *M. monoceros*.
- At Kakinada, the trawlers landed 4956 t of penaeid shrimps from inshore grounds with CPH of 9.2 kg. The penaeid landing at Visakhapatnam by small mechanised trawlers and sona boats was estimated as 1896 t and 6280 t with CPH of 2.73 kg and 5.33 kg respectively. *M. monoceros, M. dobsoni* and *P. stylifera* were the main species observed in the shrimp fishery of these two centres. Size range of *M. dobsoni* and *M. monoceros* was 41-115 mm and 51-195 mm respectively.
- The estimated deep-sea shrimp landing from Quilon Bank at Sakthikulangara and Cochin Fisheries Harbour amounted to 19,003 t with catch rate of 72.48 kg. The catch and CPH showed an improvement of 60% and 82% over the previous season respectively. Pandalids (*Heterocarpus* spp and *Plesionika* spp) formed 2/3rd of the catch and the rest by penaeids (*Aristeus alcocki* and *Metapenaeopsis andamanensis*). Appreciable quantities of deepsea shrimps were caught off Tuticorin, Chennai and Bairavapalem.
- Trammel nets landed 78 t of *F. indicus* (size range 106-200 mm) at Vizhinjam during May-November'03. The peak breeding period was May-June. At Manakudy bottom set gill nets caught 30 t of *F. indicus* with catch rate of 3.5 kg/unit during June-July '03 and mature females formed 58% of the catch.

PROJECT CODE	**CRU/CAP/02**
PROJECT TITLE	**Stock assessment and management of non-penaeid shrimp Resources of India**
SCIENTISTS	**V.D.Deshmukh,** K. Asokakumaran Unnithan, Miriam Paul and Rekha Devi Chakraborty
CENTRES	Mumbai, Veraval and Kakinada

The investigations on the non-penaeid shrimp resource were carried out from Veraval (Nawabundar) in Gujarat, Kakinada (Bhairavapalem) in Andhra Pradesh and Mumbai (New Ferry Wharf, Sassoon docks, Versova and Arnala) in Maharashtra. The resource was landed by the traditionally operated bag net locally called 'dol' net in Maharashtra and Gujarat. But, the shrimp trawlers exploited the non-penaeid shrimps in larger quantities in all the three states.

Beach drying of non-penaeid prawns in Mumbai

Trawl fishery

- Trawlers at Veraval, Mumbai and Kakinada landed 7,474 t, 4,175 t and 2,568 t of non-penaeid prawns respectively. The catch rates were 2.8, 2.4 and 4.8 kg/hr at Veraval, Mumbai and Kakinada, respectively. Trawling at Veraval and Mumbai was in 20-50 m depth but at Kakinada it was up to 150 m. Therefore catch rates at the former centres were comparable but at Kakinada they were high owing to *Parapandalus* sp. which is a deep water species.
- Compared to 2002-2003 the non-penaeid prawn catch declined by 55.7% and 14.1% at Veraval and Kakinada but increased by 40.7% at Mumbai.
- At Veraval *A. indicus* remained the dominant species (99.4%) but at Mumbai and Kakinada *N. tenuipes* dominated the trawl catches contributing 97.7% and 46.6%, respectively.

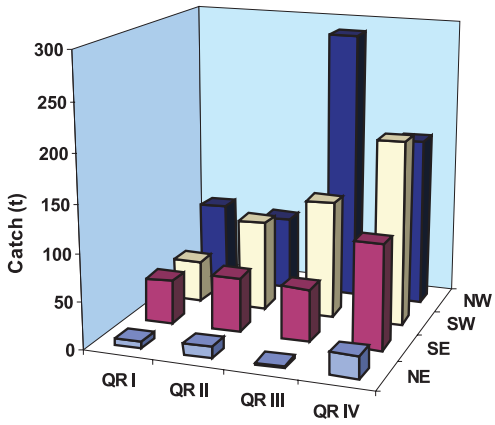
Dol net fishery

- Dol nets in Saurashtra zone (Nawabundar, Rajapara and Jaffarabad centres) and in Mumbai zone (New Ferry Wharf, Sassoon docks and Arnala centres) landed estimated catch of 25,415 t and 1,384 t, contributing 34.5% and 36.3% to the total fish landed, respectively. The catch rate at the former was 26 kg/haul and at the latter 5.9 kg/haul. The discrepancy in catch rates of the two zones is largely due to operation of dol nets in inshore waters in the latter zone.
- Compared to 2002-03, the catch and the catch rate of non-penaeid prawns in Saurashtra zone declined by 6.2% and 10.2% respectively. This decline was mainly evident in the catch of *Acetes* spp. In Mumbai zone too, at NFW the catch and the catch rate declined by 41.1% and 33.8% respectively.
- *Acetes* spp. is the most important component in all the centres whereas *N. tenuipes* contributed more than 30 % in Arnala and Saurashtra.
- Mean size of *N. tenuipes* from trawl net was 48.5 mm at Mumbai and 52.3 mm at Kakinada. Peak spawning at Mumbai was in April and September, whereas in Kakinada and Nawabundar it was in August.

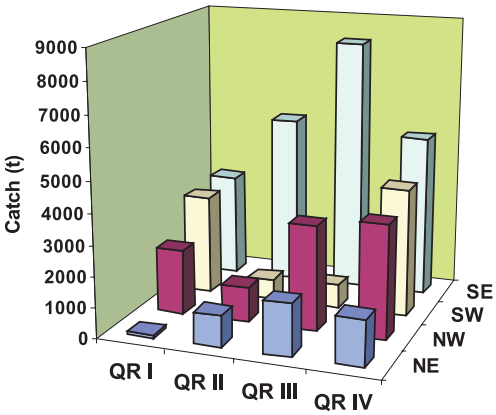
Mortality parameters of *N. tenuipes* exploited by the trawlers at Mumbai

Sex	Males	Females
Parameters		
Total mortality coefficient (Z)	9.17	9.02
Natural mortality coefficient (M)	3.54	3.52
Fishing mortality coefficient (F)	5.63	5.50
Exploitation ratio	0.61	0.61

PROJECT CODE	**CRU/CAP/03**
PROJECT TITLE	**Investigations on the resource characteristics and development of management strategies for lobsters and crabs**
SCIENTISTS	**Mary K.Manisseri,** V.D.Deshmukh, M. Rajamani, K.R. Manmadhan Nair, K. Asokakumaran Unnithan, K.K.Philippose, P.T.Sarada, A.P. Dineshbabu, Joe K.Kizhakudan, K.N. Saleela and Rekha Devi Chakraborty
CENTRES	Cochin, Veraval, Mumbai, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai and Kakinada



Regionwise quarterly landing (t) of lobsters in 2003-`04



Regionwise quarterly landing (t) of crabs during 2003-`04

Lobster fishery

- Total landing (provisional) of lobsters by trawlers during the year 2003 was 1218 t showing a decline of 8.6% when compared to that of the previous year. The trend of decline in the catches was reported from Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and West Bengal. Kerala reported maximum landing (32%) followed by Maharashtra (31%), Tamil Nadu (16%) and Gujarat (15%). The decrease in the state of Gujarat which had reported maximum statewise annual landing throughout the last decade needs special attention.
- At Veraval, lobster landing decreased from 23 t during 2002 to 10 t during 2003. *Thenus orientalis* (61%) and *Panulirus polyphagus* (39%) constituted the fishery.
- Only one species of lobster, *P. polyphagus*, was landed (142 t) at Mumbai during the year. Peak landing was reported during September-December. Ovigerous females occurred in all the months (26%) with a peak in September (64%). Statistical studies have shown that exploitation of the lobster fishery during the year reached an alarming ratio of 0.85 in case of both males and females.
- The total landing of lobsters from the "Quilon Bank" along the Kerala coast, during 2003 was 342 t as against 361 t during the previous year. The deep sea lobster *Puerulus sewelli* dominated the fishery. The total length ranged from 86 mm to 205 mm in males and 81 mm to 205 mm in females.
- The total landing of lobsters by bottom-set gill net at Tuticorin was 6 t. *P. ornatus* dominated the catches (58 %) followed by *P. homarus*. At Chennai, trawlers landed about 33 t of lobsters. *T. orientalis* dominated the fishery.
- Regionwise analysis of the data showed that maximum landing of lobsters was from the northwest coast (45%) followed by the southwest (33%) and southeast (19 %) coasts. Catch was maximum during the fourth quarter (36 %) followed by the third quarter (33%) of the year.

Crab fishery

- The provisionally estimated total catch of crabs by trawlers during 2003 was 41,150 t. The landings increased in almost all the maritime states when compared to those of the previous year. Tamil Nadu contributed maximum (36%) to the fishery followed by Gujarat (18%), Kerala and Andhra Pradesh (13% each).

- *Charybdis feriatus* predominated the fishery at Veraval and Mumbai. Peak landing was reported in September. Carapace width of *C. feriatus* ranged from 41 mm to 100 mm.
- *Portunus sanguinolentus* predominated the fishery at Mangalore, Calicut, Cochin, Vizhinjam, Chennai and Kakinada. Carapace width ranged from 61 mm to 155 mm in males and 56 mm to 140 mm in females with the modal class at 76-80 mm.
- Bottom-set gill nets landed 154 t of crabs at Tuticorin, with *P. pelagicus* (96 t) dominating the fishery. *P. pelagicus* was the dominant species in both the trawl landings (547 t) and bottom-set gill net catches (11 t) at Mandapam also. The modal size groups were 140-144 mm in males and 125-129 mm in females.
- Regionwise landing of marine crabs showed that maximum catch was from the southeast coast (49 %) followed by the northwest (23 %) and southwest (19 %) coasts. Quarterwise landing was maximum during the fourth quarter (32 %) followed by the third quarter (31 %) of the year. The prices ranged from Rs.15/- to Rs.60/- per kg at the landing centres.

- The provisionally estimated total landing of lobsters by trawlers during 2003 was 1218 t. A trend of decline was noticed in the catches in all the maritime states.
- The total landing of crabs by trawlers during 2003 (41,150 t) showed an increase of 13.7% when compared to the catches of the previous year.
- Based on the recommendations made by CMFRI, the Ministry of Commerce and Industry, Govt. of India issued a Notification in July 2003 on the "Minimum Legal Size" (MLS) for 4 species of commercially important lobsters, prohibiting export of lobsters below the "MLS".

PROJECT CODE	**CRU/CAP/04**
PROJECT TITLE	**Taxonomy of important crustaceans**
SCIENTISTS	**K. Asokakumaran Unnithan,** Josileen Jose, A.P. Dineshbabu, Joe K. Kizhakudan and Miriam Paul
CENTRES	Kakinada, Chennai, Cochin, Mangalore, Veraval and Mumbai

Kakinada: Observations on crustacean landings by different crafts and gears at different centres in space and time were continued to record occurrence of different species of shrimps, lobsters, crabs and stomatopods, apart from those already recorded. Six crabs belonging to the families Portunidae, Dorippidae and Calappidae, one species of lobster (*Panulirus polyphagus*) and one species from Crangonidae family were collected from the trawl catch and their identity confirmed.

Chennai: Five species of penaeid shrimps, three species of non-penaeids, six species of crabs from five families, two species of lobsters and five species of stomatopods from two families were recorded.

Mangalore: Eleven species of penaeid shrimps, three species of crabs, two species of deep sea lobster (*Puerulus sewelli*, *Nephropsis* sp.) and one species of squilla were recorded.

Veraval: Five species of penaeid shrimps, one species of non-penaeid shrimp and one species of crab were recorded and their identity confirmed.

Mumbai: Sixteen species of penaeid shrimps under Penaeidae, one species (Solenoceridae), three species (Alpheidae), three species (Sergestidae), three species (Palaemonidae), two species (Hippolytidae), one species (Mysidaceae), three species of lobsters (Palinuridae) and eleven species of crabs were collected, identified and preserved. A reference collection of the above species was built up.

PROJECT CODE	**CRU/CUL/01**
PROJECT TITLE	**Broodstock development, selective breeding and restocking of marine shrimps**
SCIENTISTS	**K.R.Manmadhan Nair,** G.Maheswarudu, U.Rajkumar, E.V. Radhakrishnan, V.S. Kakati and K.K.Philippose
CENTRES	Mandapam Camp, Visakhapatnam, Cochin and Karwar.

Doctor Shrimp, *Stenopus hispidous* (Adult)

13 days old larva of Doctor shrimp

Breeding, seed production and searanching of *Penaeus semisulcatus*

- During the period under report, 45 sets of experiments on spawning and larval rearing of *Penaeus semisulcatus* were carried out. A total of 30,06,790 nauplii were produced. Altogether 20,01,866 (2 million) PL were produced. The rate of survival from nauplius to postlarva ranged from 51.87% to 89.7% with an average survival of 66.6%. All the larvae (except 10,000 used in nutrition experiments) produced in these experiments were sea ranched in the Gulf of Mannar.
- For rematuration studies unilateral eye stalk ablation was carried out on 5 females. The ablated shrimp were fed with squid meat, clam meat and the intertidal oligochaete *Pontodrilus bermudensis*. Due to handling stress 2 animals died and the remaining showed ovary development and matured in a week. These were used for spawning, and larvae produced from ablated females were normal in all respects and comparable to those produced from wild spawners.

Breeding of the Doctor shrimp *Stenopus hispidous*

- A major success in breeding and early larval development of the high valued ornamental shrimp *S. hispidous*, commonly known as Doctor shrimp, was achieved at Marine Research Aquarium at Calicut Research Centre. The larvae, hatched out from berried females brought from Androth Island of Lakshadweep, were reared to post larvae. Larvae were fed on microalgae, rotifers and *Artemia* nauplii during different stages of development.

PROJECT CODE	**CRU/CUL/02**
PROJECT TITLE	**Breeding and seed production of lobster and crabs**
SCIENTISTS	**E.V. Radhakrishnan,** Josileen Jose, K.R. Manmadhan Nair, S. Lakshmi Pillai, V.S.Kakati, Joe K. Kizhakudan and K.N. Saleela
CENTRES	Cochin, Chennai, Mandapam, Calicut, Karwar and Vizhinjam

Broodstock development and breeding of *Thenus orientalis*

- Maturation and breeding of the commercially important slipper lobster *Thenus orientalis* and *Scyllarus rugosus* were achieved at Kovalam Field Laboratory, Chennai. The phyllosoma larvae were reared to settlement for the first time in India. The technology comprises broodstock constitution and management, induced maturation, larval culture, feed development and harvest of postlarvae.
- Broodstock of the slipper lobster *T. orientalis* was constituted from wild collection of juveniles and sub-adults from a gill net fishery for the lobsters near Kovalam, Chennai.

- The broodstock was held in rectangular 1 tonne capacity FRP tanks fitted with external biological filters. Faster gonadal development was noticed on feeding with fresh *Meretrix casta* meat.
- Mating in captivity was noticed in lobsters on attaining 65-75 mm carapace length.
- Oviposition was completed within 6-8 hours after mating and the jelly-like externally deposited spermatophore was lost within 12 hours.
- Phyllosoma larvae were hatched out after 35 days of incubation.

Larval rearing

- Healthy larvae were stocked at 5 nos/l and fed on chopped clam meat and hydromedusae.
- Larvae after passing through four morphologically distinct stages metamorphosed into 'nisto' (postlarva) on the 26th day after hatching.

The intermoult duration of larvae of *Thenus orientalis*

Stage	Intermoult duration (days)
Phyllosoma I (1st instar)	1
Phyllosoma I (2nd instar)	6
Phyllosoma II	5
Phyllosoma III	7
Phyllosoma IV	7

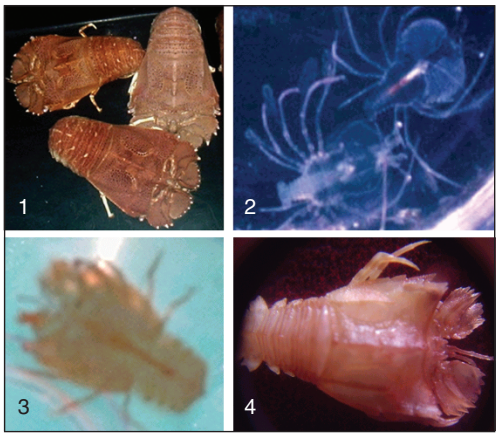
- 'Nisto' is a non-feeding stage and moulted to the juvenile stage on the fourth day. Survival from stocking to nisto was 22 % and from nisto to juvenile, 100 %.

Broodstock development, breeding and larval rearing of *Scyllarus rugosus*

- *S. rugosus* is a smaller species of high ornamental value. Settlement of the phyllosoma larvae to postlarvae ('nisto') occurred 32 days after hatching.
- Larvae were fed on *Artemia* nauplii and chopped clam meat.

Broodstock development and breeding of spiny lobsters

- Broodstock of four species of spiny lobsters, *Panulirus homarus*, *P. ornatus*, *P. versicolor* and *P. longipes* was maintained in a 10-tonne FRP tank with recirculating system.
- *P. homarus* spawned three times and viable phyllosoma larvae were obtained from all the spawning.
- *P. longipes* matured, mated and spawned for the first time in captivity.
- A closed recirculatory system for rearing phyllosoma larvae was fabricated and installed and larval culture experiments were initiated. Larvae of *P. longipes* were stocked and fed on *Artemia* nauplii.



1) Brood stock of *Thenus orientalis*
2) 4th (final) stage Phyllosoma lavae
3) Nisto (Post Larva)
4) First juvenile (4 Days old)

- Major breakthrough in breeding and hatchery production of two species of Scyllarid lobsters, *Thenus orientalis* and *Scyllarus rugosus* was achieved at Kovalam Field Laboratory, Chennai.
- Successful hatchery production of seeds of the commercially important slipper lobster, *T. orientalis* was accomplished for the first time in India and is the second instance globally.
- Completion of larval cycle of *T. orientalis* was achieved in 26 days and *S. rugosus* in 32 days.

Breeding and larval rearing of *Portunus sanguinolentus*

- Optimal salinity for rearing *P. sanguinolentus* larvae is 30-35 ppt.
- The Point of No Return (PNR) and Point of Reserve Saturation (PRS) for the zoea larvae of *P. sanguinolentus* is 24 hrs and 48 hrs., respectively.

PROJECT CODE	**CRU/CUL/03**
PROJECT TITLE	**Organic farming of *Penaeus semisulcatus***
SCIENTISTS	**K.R.Manmadhan Nair,** P. Vijayagopal and Bindu Sulochanan
CENTRES	Mandapam Camp

Standards for organic agriculture farming have been developed in different parts of the world by various International Organisations. However, standards for organic fish farming was developed by Natureland, Germany.

The standards for hatchery production of organic shrimp seeds and farming of *Penaeus semisulcatus* are being developed as shown below:

i) Broodstock from wild or from organic culture farm.

ii) Maturation and breeding by natural means without using any chemicals or hormones.

iii) Hatchery production of seeds using naturally produced live feeds (no inorganic fertilizers, chemicals, antibiotics).

iv) Low density stocking and efficient water management. The effluent quality shall be similar to the inlet water.

v) Formulation of grow out feed using natural low-protein ingredients from a predominantly vegetable source.

vi) Creation of natural feeding areas in the pond (seaweed, sea grass, mangroves).

The standards which are to be approved by a National/International agency. Farming operations are yet to be carried out.

MOLLUSCAN FISHERIES DIVISION

The Molluscan Fisheries Division implemented 7 in-house research projects and 7 sponsored projects. The exploitation of molluscan resources was nominated and trends were analysed all along the Indian coasts. A major breakthrough was achieved by scientists of the division completing the technology for tissue cultured pearls for which a global patent has been filed.

Mariculture production of bivalves continued to increase and the development of a semi automated mussel seeder would increase efficiency of farmers and reduce their drudgery. The division organised several training programmes to help outreach mariculture technologies.

PROJECT CODE	**MOL/CAP/01**
PROJECT TITLE	**Fishery and biological characteristics of exploited cephalopod resources**
SCIENTISTS	**K.S. Mohamed**, R. Sarvesan, G.S. Rao, A.C.C. Victor, V. Kripa, P.K. Asokan, S. Thomas, G. Sasikumar, M.K. Anil, B. Ignatius
CENTRES	Mumbai, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Visakhapatnam

Investigations were made from five centres along the west coast of India viz., Mumbai (New ferry Wharf), Mangalore (Mangalore & Malpe), Calicut (Puthiyappa), Cochin (Cochin, Vypeen, Munambam, Neendakara & Sakthikulangara) and Vizhinjam, and five centres along the east coast, Tuticorin, Mandapam (Mandapam, Pamban & Rameswaram), Chennai, Kakinada and Visakhapatnam. Trawl units undertaking daily and multi-day voyages contributed more than 90% of the cephalopod catch. At Vizhinjam, hooks & lines operated from mechanized and non-mechanized crafts and boat seines accounted for entire landings. The landings along the west coast accounted for the bulk of the production. The all India production of cephalopods is estimated as 1, 27,000 tonnes which is 22% more than the previous year.

The 22% increase in national cephalopod production was mainly due to steep increase in catch and catch rates at Mumbai, Mangalore-Malpe, Mandapam-Rameshwaram and Vizhinjam. The catch and catch rates decreased at all other centres, especially in Kerala, Tamil Nadu and Andhra Pradesh. Maximum increase (113%) was observed in Mangalore- Malpe and this could be on account of the sizeable magnitude of spawning congregations of squids observed in the area during the previous year.

Species Composition

Among cuttlefishes, *S. pharaonis* was the dominant species along the west coast, while it was *S. aculeata* in Andhra Pradesh. Among squids *L. duvauceli* was the dominant species along both west and east coast, excepting at Mandapam, Rameswaram, Pamban, and Tuticorin where *S. lessoniana* was the dominant species.

At Cochin, there was a remarkable increase in the catch of doryteuthid squids and the octopus catch, especially that of *O. membranaceaous* and *O. dollfusi*, showed a notable increase, compared to 2002.

Seasonal Abundance

Peak abundance of cephalopods during different seasons as reflected by the catch rates are shown in table below. Along the west coast peak

Seasonal abundance of cephalopods as indicated by catches rates; primary peaks are indicated first and secondary peaks subsequently

Centre	Period
Mumbai	April, January-March
Mangalore	August, May-June, September-October
Malpe	August, May-June
Puthiyappa	August, September-October
Cochin	May, August-September
Vizhinjam	February, August-October
Tuticorin	August-October
Mandapam	June, August-October
Rameswaram	June-July, December
Pamban	April, October-November
Chennai	July-August
Kakinada	July-August, October
Visakhapatnam	July, September-December

season of abundance was post-monsoon, except in Mumbai where it was pre-monsoon. In the east coast primary peaks were mostly pre-monsoon periods.

Species composition of cephalopods landed at different centres in percentage

Group/ Species		Cochin	Mangalore-Malpe	Calicut	Tuticorin	Mandapam-Rameswaram	Chennai	Kakinada	Visakhapatnam	Vizhinjam	Mumbai
Cuttlefishes	***Sepia pharaonis***	57	35	9	47	27	35	36	38	35	15
	S. aculeata	0	0	30	9	25	13	25	44	0	18
	S. prashadi	1	2	0	5	0	2	0	0	0	0
	S. elliptica	2	6	0	0	0	6	0	0	0	0
	S. brevimana	0	0	0	0	0	0	4	0	0	0
	S. trigonina	0	0	0	0	0	0	0	0	0	0
	Sepiella inermis	2	0	4	0	7	4	17	9	0	6
Squids	*Loligo duvauceli*	13	53	44	5	5	25	15	9	60	58
	L. uyii	0	0	0	0	0	0	1	0	0	0
	Doryteuthis singhalensis	3	0	0	0	0	5	1	0	5	0
	D. sibogae	5	0	1	5	0	8	1	0	0	0
	Sepioteuthis lessoniana	0	0	0	26	19	0	0	0	0	0
Octopus	*Octopus membranaceaous*	10	4	0	3	0	1	0	0	0	0
	O. dollfusi	6	0	0	0	0	0	0	0	0	0
	O. lobensis	1	0	0	0	0	0	0	0	0	0
	Octopus sp.	0	0	12	0	17	1	0	0	0	3
	Cistopus indicus	0	0	0	0	0	0	0	0	0	0

Biology of Key Species

Loligo duvauceli

At Mangalore, size range in DML was 60-370 mm. Larger modal lengths were observed during post-monsoon coinciding with peak breeding season. The annual mean length was 149 mm at Mangalore and 131 mm at Malpe. At Rameshwaram-Mandapam, size ranged from 40-180 mm DML with mean sizes at 105 and 103 mm respectively. At Visakhapatnam size range in DML was 50-160 mm and above 100 mm all animals were in mature condition.

Sepia pharaonis

At Cochin, length in the fishery ranged from 50 – 300 mm DML. Multiple modes were seen in all the months. Peak recruitment to the fishery took place in Feb-Mar. Mature females were dominant in Nov-Dec indicating peak breeding. In all other months immature animals dominated in catches. However, mature males were observed in all months. At Rameshwaram-Mandapam, size ranged from 80-280 mm DML with mean sizes at 180 and 169 mm respectively. At Visakhapatnam size range in DML was 70-280 mm.

Stock Dynamics

The annual total mortality rates of *L. duvauceli*, *S. pharaonis*, *D. siboagae* and *O. membranaceous* stocks exploited from Cochin Fisheries Harbour were estimated with available growth parameters using the length converted catch curve. The total mortality rates increased in the case of *S. pharaonis* and *D. sibogae* and declined in the case of *L. duvauceli* and *O. membranaceous*.

An analysis of mortality and exploitation rates and standing stock and biomass during the 1997-2002 periods indicates that the Indian squid *Loligo duvauceli* stocks at Visakhapatnam, Kakinada, Mumbai, Mangalore and Calicut are under heavy exploitation pressure. Similarly, the needle cuttlefish *Sepia aculeata* stocks in Rameshwaram and the pharaoh *Sepia pharaonis* stocks in Vizhinjam are also being exploited above the optimum level. *S. pharaonis* stocks in Cochin and *S. aculeata* stocks in Visakhapatnam are under exploited. In general, cuttlefish and octopus stocks are lightly exploited along both coasts.

Population parameter estimates of major cephalopod stocks during 1997-2002 period

Location	Species/Stock	Mortality Rate - Z	Natural Mortality - M	Fishing Mortality -F	E = F/Z	Yield (Y)	Standing Stock - Y/F	Biomass Y/U
Rameswaram	*L. duvauceli*	7.26	2.86	4.40	0.61	65	15	108
	S. pharaonis	3.74	1.69	2.05	0.55	201	98	367
	S. aculeata	7.48	2.22	5.26	0.70	227	43	323
Mandapam	*L. duvauceli*	5.93	2.86	3.07	0.52	16	5	31
	S. pharaonis	4.92	1.69	3.23	0.66	117	36	179
	S. aculeata	6.09	2.22	3.87	0.64	106	28	168
Visakhapatnam	*L. duvauceli*	9.25	2.86	6.39	0.69	89	14	129
	S. pharaonis	3.74	1.69	2.05	0.55	76	37	139
	S. aculeata	3.25	2.22	1.03	0.32	86	84	272
Kakinada	*L. duvauceli*	14.39	2.86	11.53	0.80	106	9	132
	S. pharaonis	5.27	1.69	3.58	0.68	168	47	249
	S. aculeata	5.16	2.22	2.94	0.57	118	40	208
Chennai	*L. duvauceli*	8.50	2.86	5.64	0.66	543	96	820
Mumbai	*L. duvauceli*	6.63	2.149	4.48	0.68	9481	2114	14025
Mangalore	*L. duvauceli*	7.77	2.149	5.62	0.72	4304	765	5949
Calicut	*L. duvauceli*	15.84	2.149	13.69	0.86	630	46	729
Cochin	*L. duvauceli*	5.71	2.149	3.56	0.62	591	166	949
	S. pharaonis	1.83	1.25	0.58	0.32	807	1398	2555
	O.membranac	4.36	2.11	2.25	0.52	318	142	617
Vizhinjam	*S. pharaonis*	4.53	1.25	3.28	0.72	1045	319	1444

Salient achievements

- All India cephalopod production was estimated as 1.27 lakh tonnes showing an increase of 22% from 2002. This was mainly due to a 39% production increase in Maharashtra.
- The exploitation rates indicate that some of the stocks are under heavy exploitation pressure. In general, cuttlefish and octopus stocks are lightly exploited along both coasts.
- *L. duvauceli* stocks at Visakhapatnam, Kakinada, Mumbai, Mangalore and Calicut are under heavy exploitation pressure.

Similarly, *S. aculeata* stocks in Rameswaram and *S. pharaonis* stocks in Vizhinjam are also being exploited above the optimum level.

- *S. pharaonis* stocks in Cochin and *S. aculeata* stocks in Visakhapatnam are under exploited.

PROJECT CODE	**MOL/CAP/02**
PROJECT TITLE	**Assessment of bivalve and gastropod resources**
SCIENTISTS	**G. Syda Rao,** R. Sarvesan, P.V. Sreenivasan, A.C.C. Victor, A. Chellam, T.S. Velayudhan, V. Kripa, Shoji Joseph, Geetha Sasikumar, P.Laxmilatha, P. K. Asokan, Sujitha Thomas N. Ramachandran, M.K. Anil & Boby Ignatius
CENTRES	Karwar, Mangalore, Calicut, Cochin, Vizhijam, Tuticorin, Mandapam, Chennai, Kakinada, Vishakhapatnam & Mumbai

Meretrix casta landing at Moorad estuary

Karwar: *Paphia malabarica* fishery from Aghanasini estuary and *Meretrix meretrix, Crassostrea madrasensis* and *Saccostrea cucculata* fishery from Kalinadi and green mussel fishery from the estuary and coastal areas were monitored. The total landings of *Paphia malabarica* was 225t, *Meretrix meretrix 2001t, Crassostrea madrasensis* 99t, *Saccostrea cucculata 84t* and *Perna viridis 212t*

Mangalore: Clam landings from Mulky estuary was 855t, showing a decrease of 45%. *Meretrix casta* and *Paphia malabarica* are the major species landed. 250t of *Villorita cyprinoides* were exploited from Nethravathi estuary and 1172t of *M. casta* from Gurupur estuary. *P. viridis* from Gangorthri to Shiroor contributed 5510t recording a decline of 35% over previous year.

Calicut: Mussel fishery was monitored from 8 major centers along the Malabar zone. The total landings were 1062 t with a catch rate of 476 kg/day. Mussel seed survey was conducted along Malabar Coast and estimated as 10,339 t, with a size range of 25-37 mm during October to December. Bivalve resources of Moorad estuary indicated that the total biomass as 3368 t in 150 ha. The major species available are *M. casta* (62%), *M. meretrix* (16%) and *C. madrasensis* (20%). 31 t of *P. malabarica* and 391 t of *C. madrasensis* were landed at Dharmadom estuary. 144 t of *M. casta* landed at Moorad and 48 t of *V. cyprinoides* and 40 t of *C. madrasensis* landed at Chaliyar.

Cochin: As estimated 30,000t of *V. cyprinoides* was landed at Vembanad Lake, showing 29% increase from that of previous year. *Paphia malabarica* landings from Ashtamudi Lake were 951 t. 3660 t of *Sunetta scripta* was exploited from coastal areas of Cochin.

Vizhinjam: Annual landings of brown mussel *Perna indica* from Vizhinjam and Muloor-Pulinkudi coast was 259 t, which is 38% less than that of previous year. The effort also decreased. Maximum landing was during October.

Mandapam: 1, 44, 862 numbers of chank (*Xancus pyrum* var. *ocuta* and *obtusa*) were landed from trawlers at Rameswaram (75%) and Mandapam (25%). The size ranged from 90-255 mm. The catch per unit effort of the chanks at Mandapam was 0.91 nos. and at Rameswaram it was 1.47 nos. 216333 nos. ornamental gastropods, *Hemifusus pugilinus* were landed at Rameswaram. The size range in the fishery was 49 to 152.

Tuticorin: Estimated *Xancus pyrum* landings were 4.2 lakh numbers caught by 52 divers. In addition to this there was 2 lakh numbers of elephant chank *Chicoreus ramosus* caught during this year.

Chennai: Recent survey indicated that green mussels were distributed in 94, 000 sq.m area, edible oysters in 60,000 sq. m and clam in 10,000 sq. m area in Uppanuru estuary near Cuddalore. 125 t of green mussel were harvested in the current year. Bivalve stock of the Uppanaru estuary varied from 71.5 t to 203.9 t. constituted by the green mussel *Perna viridis* (52.8%), edible oyster *Crassostrea madrasensis* (45.99%) and the clams, *Marcia opima* and *Paphia malabarica* (1.2%). The oyster *Saccostrea cucculata* and the clams *Meretrix casta* and *Meretrix meretrix* also were recorded in limited quantities.

Kakinada: Total landing from Kakinada bay was 2667t of bivalves and gastropods. The landings increased by 19% and effort by 22%. The catch rate declined. Through the ban on molluscan shell fisheries by AP State Forest Department continued this year also, *Anadara granosa* (38%) and *Cerithidea fluviatlis* (42%) were exploited from Kakinada Bay.

Visakhapatnam: About 887t of bivalves were caught from Bhimli estuary. *M.casta*, *M. meretrix* and *A. granosa* are the clam species forming 72% followed by edible oyster *C. madrasensis* (28%).

Hemifusus sp.,*Lambis lambis* and *Xancus pyrum* landings at Rameswaram trawl landing centre

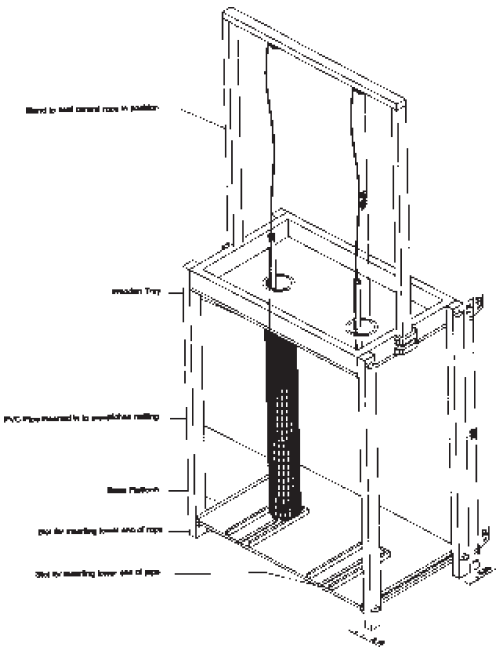
Species wise landings of bivalves and gastropods in tonnes during 2003-2004

	Resource	Karnataka	Kerala	Tamil Nadu	Andhra Pradesh	Total
	Sunetta scripta	---	3660.0	---	---	3660.0
	Paphia malabarica	33.8	982.0	---	15.9	1031.7
	Meretrix casta	1941.5	144.0	---	561.5	2647.0
Clams &	*Meretrix meretrix*	213.5	---	---	501.1	722.6
Cockles	*Villorita cyprinoides*	250.0	30048.0	---	940.8	31238.8
	Anadara granosa	---	---	---	948.1	948.1
	Marcia opima	---	---	---	0.5	0.5
	Geloina bengalensis	---	---	---	12.2	12.2
	Total	**2438.8**	**34834**	0	**2988.1**	**40260.9**
Oysters	*Crassostrea*	188.0	511.0	---	400.1	1099.1
	madrasensis	---	---	---	---	0
	Saccostrea cucculata	---	---	---	---	---
	Placenta plancenta				263.5	263.5
	Total	**188.0**	**511.0**	0	**663.6**	**1362.6**
Mussels	*Perna viridis*	5722.4	1062.0	125.0	---	6909.4
	Perna indica	---	259.0	---	---	259
	Total	**5722.4**	**1321.0**	**125.0**	**---**	**7168.4**
Gastropods	*Xancus pyrum*	---	---	469.9	---	469.9
	Hemifusus sp.	---	---	5.0	0.97	5.97
	Cerethedea sp.	---	---	---	1133.3	1133.3
	Telescopia sp.	---	---	---	134.5	134.5
	Thais sp.	---	---	---	34.0	34
	Chicoreus ramosus	---	---	172.5	---	172.5
	Total Gastropods			**647.4**	**1302.77**	**1950.17**

Salient achievements

- All India bivalve production was 48,792 t showing 16% decrease over that of 2002.
- Among the bivalves, the black clam *Villorita cyprinoids* was the major clam exploited, followed by *Sunetta scripta.*
- Emergence of green mussel fishery in the high saline zones of estuaries of Kerala and south Karnataka coast during the late post monsoon and pre-monsoon period has mainly contributed for increased mussel production.
- Among gastropods, *Cerethidea* sp was the major component followed by *Xancus pyrum*. Dead shells of *Cerethidea* were collected at Vishakhapatnam. Many ornamental gastropod species form bycatch at various trawl landing centers.

PROJECT CODE	**MF/CUL/01**
PROJECT TITLE	**Technological feasibility studies and up-gradation of Molluscan Mariculture**
SCIENTISTS	**K.K.Appukuttan,** A.C.C. Victor, V.Kripa, R. Sarvesan, P.V. Sreenivasan, G. Syda Rao, A. Chellam, P. Muthiah T. S. Velayudhan, K.S. Mohamed, Geetha Sasikumar, P. Laxmilatha, P.K. Asokan, Sujitha Thomas, & I. Jagadis
CENTRES	Mangalore, Calicut, Cochin, Tuticorin, Mandapam, Chennai, Kakinada, & Vishakhapatnam



Mussel Seeder - 3

Cochin: - The prototype I of semi automated mussel seeder was modified by making provision for seeding two ropes from a single unit simultaneously. Prototype II fabricated with aluminium showed good efficiency in terms of attachment of mussel seed and reduction in manpower. Prototype III made of wood was developed with further improvements for increased durability. The cost of Mussel seeder using Mahogany wood was estimated as Rs.2500 / unit. After the experimental trials at Kollam it was demonstrated to the farmers and Panchayat officials at Korapuzha (Calicut district) and Vallikunnu (Malappurum district) in North Kerala where large scale mussel farming is done in estuaries. Three scientific interventions were made in mussel farming activities for improved production.

1. Low cost flexible plastic strip (FPS) introduced instead of the nylon rope as the core material for better attachment of the seed and reduction in expenditure.
2. Pre stitched biodegradable tubes for holding the seed and reduction in expenditure
3. Semi automation of mussel seeding process for speedy seeding and reduction in labour.

The seeding machine was demonstrated to mussel farmers in Kollam, Vallikunnu and Korapuzha. Farmers were enthusiastic about the benefits of the seeder and have requested for financial support from local panchayat bodies to manufacture the same.

Allometric relationships of green mussel *Perna viridis* farmed in two different ecosystems viz. estuary and bay were analyzed and it was found that the growth in length and other shell dimensions were similar in the estuary and the bay but the rate of increase in meat weight to the length was significantly different in the two ecosystems, indicating meat weight proportionate to the length is higher in the bay.

The condition index of mussels at Kollam was highest during June and the peak spawning was during July- August. The condition index also improved during the period September to November and a second spawning with lesser magnitude was observed during October -November.

A new bivalve demonstration farm for edible oyster was set up at Sattar Island in the northern part of Vemband Lake as part with active participation of the members of the women Self Help Groups of Vadakkekara Panchayat, Ernakulam district and 500 oyster rens were stocked.

8 training programmes were conducted in the villages around Ashtamudi and Vembanad Lake with active support from BFFDA and Grama Panchayats. The villagers especially women farmer groups were trained in preparation of oyster rens and mussel seeding.

A mussel farming training programme was jointly organized at Goa by ICAR Research Complex Goa and CMFRI. 60 participants were there including Minister for Fisheries Goa, farmers, fishery officials, Researchers, planners and entrepreneurs attended this programme. A training manual was also released. A manual on mussel farming with 16 chapters including stepwise instructions on practical aspects was prepared.

Kozhikode

With the assistance of ADAK, 27 mussel farms were established at Korapuzha and helped the farmers in various farming activities in Byndoor, Karwar, Goa, Vengur and Ratnagiri. Mussel culture training was conducted at Majali (Raft culture) and at Sunkeri (Rack culture) near Karwar, Karnataka.

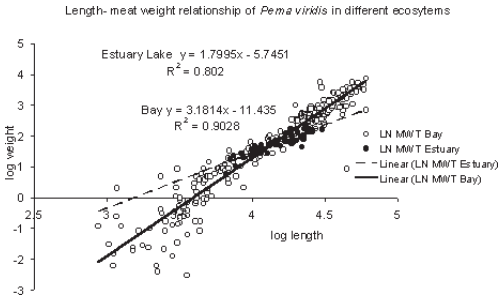
To monitor spat settlement in wild, fuzzy and coir ropes were knitted as a mesh with an average size of about 2.5 x 2.5 m and the gunny bags each covering an area of about 1.25 x 1.25 m were spread on the rocks in the natural mussel beds at Elathur.

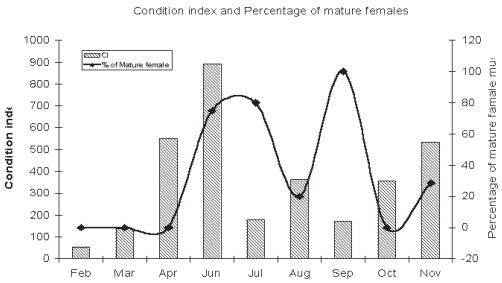
A total of 25 kg quality meat was harvested from 500 oyster rens from the demonstration farm at Korapuzha estuary. The meat percentage was 10 %. Oysters grown for 105 days in coconut shells reached 43.26 mm length with 71g total weight and had perfectly round cup shape to suit the individual oyster trade. 41 mussel farmers, of Korapuzha estuary got ADAK – CMFRI support and harvested 62 t mussels with 20kg/meter production. The meat content was more than 30 %.

In 60 sq m bivalve culture farm of in the Moorad estuary, 545 rens were suspended for oyster-spat settlement and *Meretrix casta* was introduced in the same farm in December 2003, in bottom set cages. The growth of clams recorded was 22.7, 24.1 and 23.75 in cages with stocking density 800, 1200 and 1600 respectively.

Mangalore

The growth rates of clam (*Meretrix casta)* kept in estuarine pens at Chitrapu gave production rates of 1.84, 2.66 and 2.93 kg / m^2 from with a stocking rate of 200 / m^2, 300 / m^2 and 400 / m^2, and survival rate was 85 %, 84% and 76 % respectively in three months. The clams grown in Bappanadu estuary showed a production rates of 1.9, 2.08 and 2.42 kg / m^2 with a stocking rate of 200 /m^2, 300 / m^2 and 400 / m^2, and showed retrieval of 88%, 81% and 70 % respectively in three months. The growth





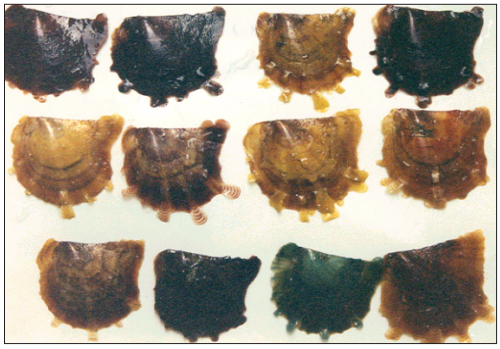
Growing edible oyster in coconut shells to produce perfectly cup-shaped oysters

increments were 11.51, 8.51 and 8.39 mm at 200 / m^2, 300 / m^2 and 400 / m^2 stocking densities. The average meat content ranged from 8.56 % to 9.35 % (wet weight). The clams harvested were in partially spent condition.

Tuticorin

A total of 169 oyster strings with hatchery produced spat set on shells were transferred for nursery rearing. 4398 young oysters of size 37.4 mm in 169 strings after nursery rearing were broadcasted in the Karapad creek. From the farmed oysters 26 kg of oyster meat were harvested.

1000 numbers of clam seeds of *Paphia malabarica* were reared from March 03 to November 03 in three different substrata i.e. sand, clayey sand and coral-sand and the survival rate observed ranged from 1.9 to 28.2% with minimum in coral sand and maximum in clay bottom.



P. maxima maintained at Vishakhapatnam laboratory

Chennai

A demonstration farm for the mussel culture involving local fishermen was set at Uppanar estuary near Cuddalore in a feeder canal bringing water from Pulicat Lake. One rack of 10m X 10m with 58m rope were seeded and suspended from the rack in February 2004. Each rope was seeded for a length of 1.5m with 1 kg / m length. Average of length of the mussel seeded was 39.5mm and average weight being 5.0 g and in March, another 40 ropes were seeded and suspended.

Vishakhapatnam

1200 pearl oysters (*Pinctada fucata*), of 70-100 mm DVM range are reared in captivity as land based onshore pearl culture. All of them are implanted with nuclei of 5-10 mm in January and May 2003. The rejections occurred mostly before 40 days.

In March 2003 live pearl oyster spats (DVM 5 – 9 mm) of silver lip pearl oyster *Pinctada maxima* were isolated from the hull of fishing vessel belonging to M/S Suvarna Rekha Marines, Pvt. Ltd. Vishakhapatnam with full cooperation of the boat crews. At the end of six months under onshore conditions, they attained a DVM of 60 – 70 mm. The survival and growth are good for the 70 specimens in the lab.

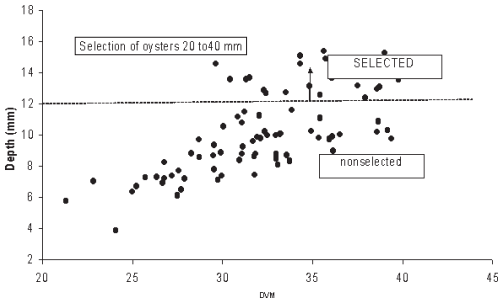
Training programmes on bivalve farming organised during the year 2003-2004

Organized by	Subject	Place	Number of days	Number of participants
BFFDA	Mussel farming	Padanna	1	29
State FisheriesDept.	Mussel farming	Kannur	1	20
MFD	Mussel farming	Calicut	1	20
MFD	Oyster farming	Sattar Island	1	120
BFFDA & MFD	Oyster farming	Thekkumbagam	1	120
BFFDA & MFD	Oyster farming	Panchanellor	1	120
BFFDA & MFD	Oyster farming	Kollam	1	120
ICAR research complex & MFD	Mussel & oyster farming	Goa	4	50
MFD	Mussel farming	Karwar	2	100
MFD	Pearl culture	Tuticorin	30	5
BFFDA & MFD	Oyster culture	Dharmadom	1	25
ADAK &MFD	Mussel farming	Elathur	1	135

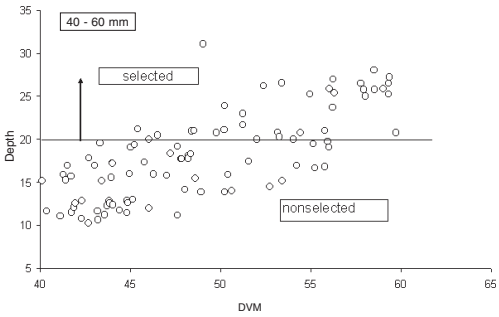
- Semi automated mussel seeding machine (prototype II and III) with a production cost of Rs. 2500 was field tested with farmers' participation in Kollam, Malappuram and Kozhikode districts in Kerala.
- Awareness campaigns on edible bivalve farming intensified by conducting more training programmes, setting up demo farms in different parts of the country.
- Training on mussel and oyster culture conducted at Goa in association with ICAR research complex, Goa from 20th to 22nd of October at Velha Goa and Madgoan.
- Scientific guidance provided to 25 women Self Help Groups to harvest 55 oysterfarms at Kayamkulam
- 500 women belonging to 50 SHGs trained in oyster and mussel farming and continued culture of bivalves with assistance from ADAK and BFFDA at Kayamkulam and Kollam
- An action plan for mussel farming in Kerala was prepared and submitted to the Govt. of Kerala for effective implementation of mussel farming in Kerala
- New demonstration farms set up at Majali (mussel – raft), Korapuzha (oyster – rack) and Sathar Island (oyster – rack) to demonstrate the techno-economic viability of mussel and oyster farming
- Live silver lipped pearl oyster *Pinctada maxima* collected from the hull of ships and reared at the onshore pearl oyster farm at Vishakhapatnam reached 60 to 70 mm from an initial length of 5-9 mm in 6 months.
- The trial production of cup shaped single oyster at Korapuzha estuary was successful.

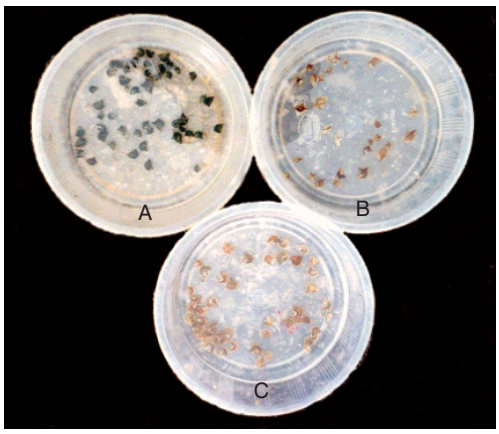
FUNDING AGENCY	**MOL/CUL/02**
PROJECT TITLE	**Selective breeding of pearl oyster *Pinctada fucata***
SCIENTISTS	**T. S. Velayudhan**, P. C. Thomas, P. Muthiah, G. Syda Rao, N. Ramachandran, S. Dharmaraj, V.Kripa, Shoji Joseph, Boby Ignatius, U. Rajkumar & C.P. Tayade
CENTRES	Cochin. Vizhinjam, Tuticorin, Mandapam, & Vishakhapatnam

The pearl oysters reared in the Kollam farm were selected based on the depth of the oysters in relation to its DVM. In the 20 to 40 mm size oysters the depth ranged between 4 to 16 mm and pearl oysters with more than 12 mm depth were selected and reared in separate cages. In the 40 to 60 mm size group, the depth of oysters ranged from 10 to 28 mm and those with depth > 20 mm were selected and reared.



2 month old spat produced in October 2003 in the Mandapam hatchery have attained 30.4 (APM), 25.11 (in) DVM, 9.82 (cavity) mm in February 2004. This growth is found very poor compared with Tuticorin, Vizhinjam and Kollam in (west coast). Selected oysters for larger depths (Thickness) to hold larger nucleus were reared in other centers and few were implanted with larger nucleus.





Selected black band (A), green band (B) and red band (c) pearl oyster spat for growth trials

Salient achievements

- Various growth parameters (DVM, APM & Cavity) were selected and tested for heretability in successive generations at Mandapam. Spats were divided into different groups based on their growth performance in hatchery and tested whether the same growth pattern was continued in the farm conditions also. Results showed that the growth difference in hatchery phase was not reflected in the farm rearing trials
- The brood stocks were selected for different traits especially larger depth to hold nuclei of 5 to 10 mm.
- Selected animals were implanted with 5-10 mm nuclei using a newly designed surgical instrument
- Spawning trials were conducted with the selected oyster stock and the larvae and spats are being reared for the pedigree analysis.

PROJECT CODE	**MOL/CUL/03**
PROJECT TITLE	**Technological up gradation of molluscan seed production**
SCIENTISTS	**P. Muthiah,** P. Laxmilatha, S. Dharmaraj, A. Chellam, P.K. Asokan, Sujitha Thomas, I. Jagadis, Boby Ignatius, & M.K. Anil
CENTRES	Calicut, Vizhinjam, Tuticorin & Mandapam

Tuticorin

Edible oyster: *Crassostrea madrasensis*

Broodstock collections were made from Machado bridge area of Karapad creek and about 290 oysters of length varying from 80 to 110 mm were used for experiments. 18 induced spawning were done in the hatchery and a total of 1.07 lakhs of spats were produced. The larvae were reared and settlement occurred on 15th to 18th day. Settlement ranged from 17 to 156 spat/shell. The percentage of settlement was 0.18 to 3.8%.

Pearl oyster: *Pinctada fucata*

During the period, 1.13 lakh spats were produced, from which 26, 950 spats were supplied to Vizhinjam Research centre for culture and pearl oyster spats of 3.9 mm stocked at density of 2000 in 1 ton FRP tanks showing 79.4 %survival.

Clam : *Paphia malabarica*

1618 *P. malabarica* broodstock ranging from 20.3 to 47.1 mm were collected from Ashtamudi Lake and induced spawning experiments were

conducted once in a month. From a single spawning in December, '03, 68, 142 seeds were produced. On the 2nd month the seeds attained a mean length of 3.5 mm (range being 1.5 – 5.2 mm) and the seeds are being reared in the hatchery.

Cephalopod:

231 hatchlings of *Sepiella inermis* released from egg clusters of F15 – F16 were reared for 166 – 199 days attaining 138 mm ML and 42g. During the period 449 juveniles and adults of *S. inermis* with an average size of 65.2 mm ML were sea ranched. 5 juveniles of *Sepia pharaonis* 110.7 – 120.8 mm (ML) were reared for 77 days. 16 juveniles of *Sepioteuthis lessoniana* 10.3 mm (ML) reared for 16 days from egg clusters collected from Van Theevu.

Mandapam

Pearl oyster: *Pinctada fucata*

Out of 8.1 million larvae produced from 5 spawning 20 lakhs of spat settled and 3.15 lakhs spat (size 2 – 7) were transferred to the farm for further rearing.

Sacred chank : *Xancus pyrum*

Totally 79 baby chanks released from egg capsules were reared. The baby chanks registered monthly growth rate of 4.59 mm in length, 2.15 mm and 1.89 g in weight. The two year old baby chanks had low growth rate of 0.43 in length, 0.25 mm width and 0.97 gm in weight / month. Baby chanks fed with different feed in captivity for 60 days, showed that those fed with earthworm had appreciable growth than those fed with clam or fish.

Vizhinjam

Cuttle fish *Sepia pharaonis* was reared from egg to adult weighing more than 525 gm. Best survival rates were obtained in the hatchlings fed with mysids in combination with Artemia. Hatchings of *Sepioteuthis lessoniana* on 3rd month attained more than 100 gm in weight. On day 105, they started laying egg capsules. Repeated spawning was observed at interval of 12 – 14 days.

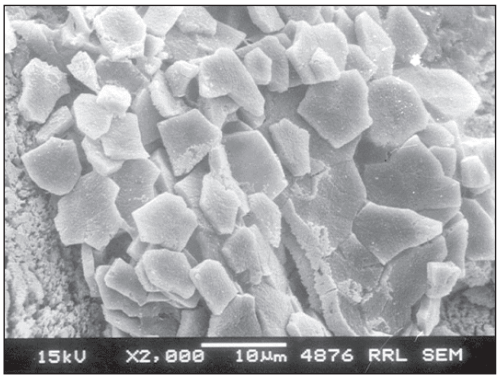
Salient achievements

- Growth rate of 150 baby chanks (*Xancus pyram*) were observed for 25 months.The monthly growth rate was 3.8mm in length, 1.9mm in width and 1.05g in weight during first year. In the second year average monthly growth rate was 0.43mm in length, 0.25mm in width and 0.97g in weight.
- Big finned squid *Sepioteuthis lessoniana* was successfully bred for the first time in India. Repeated spawning was obtained under captivity in 4 months from hatching. *Sepia pharaonis* were reared from egg stage to mature condition within 5 months
- As a part of stock enhancement, 3.0 lakhs of 5.0 mm spats of pearl oyster were produced and transplanted to the pearl farm at Mandapam

Deposition of egg mass of *Sepia pharaonis* in Indian tanks

FUNDING AGENCY	**MOL/CUL/04**
PROJECT TITLE	**Marine pearl production through tissue culture**
SCIENTISTS	**S. Dharmaraj,** P. Muthiah
CENTRES	Tuticorin

Shell beads used in earlier organ cultures of mantle tissue of both pearl oyster and abalone were analyzed through the Scanning Electron Microscope (SEM) for the coating, if any, on the beads. The chemical crystals deposited on the beads were also analyzed by Energy Dispersive X-Ray Micro-analyzer (EDS). The analysis revealed the formation of organic matrix, nacreous layer and deposition of crystals. These results were obtained simultaneously in both pearl oyster and abalone and were exactly similar to earlier studies in Japan on shell regeneration and restructure. The formation of nacreous layer *in-vitro* culture was considered to be a stepping-stone for *in-vitro* pearl production. Further work on organ culture of mantle tissue of pearl oyster and abalone is being carried out to ascertain whether the pearl growth is continued for longer duration in *in-vitro* condition.



Ultrastructural view of crystals deposited on a shell bead in *in vitro* culture of mantle of *P. fucata*

The effect of calcium on cell proliferation and secretion of nacre was studied. The concentration of 100, 200, 300 and 400µl/ml were tested along with a control with medium alone. Numerous cells were proliferated from the explant tissue in both cases and hence no significant difference could be noticed.

Salient achievements

- Success achieved in the organ culture of mantle of pearl oyster and abalone.
- A breakthrough has been achieved by developing a tissue culture technology for marine pearl production using the pearl oyster, *Pinctada fucata* and abalone *Haliotis varia* for the **first time in the world**. This technology can be easily extended to other pearl producing molluscs, and unlike the *in-vivo* pearl culture, *in-vitro* technology gives ample scope for manipulation of pearl quality and also increased pearl production.

PROJECT CODE	**MOL/BIOD/01**
PROJECT TITLE	**Biodiversity of Marine Molluscs**
SCIENTISTS	**Shoji Joseph,** K. K.Appukuttan, R. Sarvesan, P.V. Sreenivasan, P. Muthiah, T. S. Velayudhan, V. Kripa, P. Laxmilatha, I. Jagadis, & Sujitha Thomas
CENTRES	Cochin, Calicut, Chennai, Tuticorin & Mandapam

Collections of cephalopods, bivalves and gastropods were done from the landing centers as well as from the coastal areas, inter-tidal areas and estuaries. Check list of recorded marine molluscs from Indian waters is prepared. So far a total of 521 species of Gastropods under 238 families and 298 genera; 248 species of Bivalves under 85 families and 115 genera: 13 species of Polyplacophores under 8 families: 11species of Scaphopoda under 7 families: 9 species of aplacophores under 6 families; and 201 species of cephalopods under 26 families are including in the checklist.

A total of 84 different species of gastropods belonging to 26 families and 32 genera were tentatively identified from the samples collected from the trawl landing centers of Mandapam, Kollam, and Cochin. 36 species of bivalves belonging to 12 different families were collected and identified

from samples from Madras, Tuticorin, Kollam, Cochin, Kozhikode and Gujarat.

Among gastropods whelks in the family Buccinidae is an important by-catch of shrimp trawlers along southern coasts and the fishery along off Kollam is supported by 2 species, *Babylonia spirata* and *Babylonia zeylanica* and have high demand in the international market. Similarly chanks *Xancus pyrum, Chicoreus ramosus, Cerethidae* spp. and *Hemifusus* spp. are other gastropods being exploited along the east and west coasts commercially. All others are landed as by-catches of the trawlers and used in the shell trade. Majority of the gastropods collected (approximately 70 species) are used in the ornamental shell trade. The rare gastropods collected include, *Conus milne-edwardsii* (endangered), *C. bengalensis, C. miles, C. striatus* and *C. geographus* from the family Conidae; *Strombus listeri* and *S. plicatus sibbaldi* (both endangered) from the genus strombus and *Lambis crocea, L. truncate and L. scropius* (three endangered) from the genus Lambis of the family strombidae, *Cypracassis rufa, Charonis tritonis,* and *Trochus niloticus* (all endangered) were also collected.

Shell landings at Sakthikulangara fishing harbour

Status of exploitation of ornamental molluscs

S No.	Family	No. species (genera)	Areas of Collection	Economic importance & Habitat	Exploitation rate
1	Trochidae #	3 (1)	Kl & Md	Ol, R	***
2	Neritidae	1(1)	Kl & Md	Ol, R	**
3	Architectonidae	2(1)	Kl	Ol, S	**
4	Cypridae	3(1)	Kl & Md	Ol & El, C,	***
5	Strombidae #	6(2)	Kl & Md	Ol & El, C, S	***
6	Tonnidae	2(1)	Kl & Md	Ol, S	**
7	Ficidae	2(1)	Kl & Md	Ol, M	**
8	Bursidae	4(2)	Kl & Md	Ol, R	**
9	Cymatidae#	2(1)	Kl & Ko	Ol, S	**
10	Naticidae	5(2)	Kl & Md	Ol, S	**
11	Cerithidae	1(1)	Kl & Md	Ol, R	**
12	Xenophoridae	1(1)	Kl & Ko	Ol, S	*
13	Turritellidae	2(1)	Kl & Md	Ol, S	**
14	Littorinidae	1(1)	Kl & Md	Ol & El, R	**
15	Muricidae	6(2)	Kl & Md	Ol & El, R	***
16	Conidae#	19(1)	Kl & Ko	Ol, S, C	***
17	Turridae	3(1)	Kl & Ko	Ol, S	***
18	Buccinidae	2(1)	Kl& Ko	Ol & El, R	**
19	Fasciolaridae#	5(2)	Kl & Ko	Ol, S	***
20	Volutidae#	4(2)	Kl& Ko	Ol, R, C	***
21	Olividae	4(2)	Kl & Ko	Ol, SB C	***
22	Turbinellidae	1(1)	Kl & ko	Ol, S, M	***
23	Volemidae	1(1)	Kl & Md	Ol, A	**
24	Nassidae	1(1)	Md	Ol, S	**
25	Potamomidae	1(1)	Kl & Md	Ol, R	*
26	Patellidae	2(2)	Md	Ol, R	*

Kl - Kollam
Md - Mandapam
Ko - Cochin

M - Muddy bottom
S - Sandy bottom
C - Coral dwellers
R - Rocky bottom
A - Algae associated

* - under exploited
** - moderately exploited
*** - heavily exploited
# - include endangered species

Ol – Ornamental
El – Edible

FISHERY ENVIRONMENT MANAGEMENT DIVISION

During the period under report, FEMD conducted research to achieve the targets through 6 Inhouse projects, 3 funded projects, 2 NATP and one ICAR Revolving fund project. In addition to this, Consultancy programmes related to environment were also implemented. The Scientists of the Division were also actively involved in the M.F.Sc. and Ph.D. programmes of PGPM.

The major achievements of the Division during the year are:

- GIS Software Training imparted at CMFRI, Cochin during 6-10 October 2003.
- First workshop to impart training on marine mammal identification at CMFRI, Cochin during 15-18 October, 2003.
- Final workshop on NATP project on Mangrove Biodiversity at CARI, Port Blair during 27-30 October, 2003.
- Final workshop on NATP project on Impact of Dams at Mangalore during 23-24 December, 2003.
- National Symposium and Exposition on Seaweeds-2004 at Cochin during 22-24 January, 2004 in collaboration with Seaweed Resources Utilization Association, Mandapam Camp.

PROJECT CODE	**FEM/01**
PROJECT TITLE	**Monitoring the environmental characteristics of the inshore waters in relation to fisheries.**
SCIENTISTS	**C.P.Gopinathan**, G.S.D. Selvaraj, V.Chandrika, T.S.Naomi, Gulshad Mohammed, P.K. Krishnakumar, S. Jasmine, V.V. Singh, P.S.Asha, K. Vijayakumaran, Rani Mary George and Bindu Sulochanan.
CENTRES	Cochin, Calicut, Mangalore, Karwar, Mumbai, Minicoy, Veraval, Tuticorin, Mandapam, Chennai, Visakhapatnam.

Regular monitoring of the environmental parameters were continued from the inshore waters of west and east coasts of India by making fortnightly/ monthly collections with the available facilities from Cochin, Calicut, Mangalore, Karwar, Bombay, Veraval, Minicoy, Tuticorin, Mandapam, Chennai and Visakhapatnam Centres with reference to water temperature, salinity, dissolved oxygen, nitrate, nitrite, phosphate and silicate. Besides, primary and secondary production of the inshore waters upto 30m depth zone were also attempted from selected Centers.

The water temperature of the inshore waters ranged from 26.7 to 32.5°C in the west and it was 26.0 to 32.4°C in the east coast. The values of salinity ranged from 10.5 ppt to 36.0 ppt in the west, while it was 27.7 to 38.0 ppt in the east. The dissolved oxygen content ranged from 1.8 to 5.2 ml/l in the west and it was 1.16 to 6.5 ml/l in the east coast. The values of both nitrite and nitrate ranged from 0.06 to 20.8mg at /l in the west while it was 0.08 to 25.0mg at /l in the east. The Phosphate values ranged from 0.04 to 8.84 mg at /l in the west and 0.03 to 7.3mg at /l in the east. The values of silicate ranged from 1.8 to 77.26 mg at /l in the west and it was 0.02 to 6.64 mg at /l in the east. The gross primary production ranged from 28.0 to 715.0 mgC/m^3/day in the west and it was 2.4 to 1162.0 mgC/m^3/day in the east coast inshore waters. The biomass of zooplankton recorded high values of 40.5 ml/100 m^3 of water in the west coast and it was 8.0 ml/100 m^3 in the east coast.

PROJECT CODE	**FEM/02**
PROJECT TITLE	**Monitoring environmental contaminants from coastal waters with reference to bioaccumulation and biomagnification in fishes**
SCIENTISTS	**P.K. Krishnakumar,** Rani Mary George, P. Kaladharan, D. Prema, George. J.P., K. Vijayakumaran, V.V. Singh, S. Jasmine, D.C.V. Easterson, P.S. Asha and Bindu Sulochanan
CENTRES	Veraval, Mumbai, Karwar, Mangalore, Cochin, Tuticorin, Mandapam, Chennai, Visakhapatnam.

The project is designed to assess the status and likely trends in quality of coastal waters with reference to industrial pollution and provide information to different stakeholders. Monthly samples from 9 CMFRI Centres covering 45 inshore sampling stations from east and west coast of India was carried out for monitoring the spatial and temporal trends in toxic trace metal concentrations.

- Anode Stripping Voltametric (ASV) technique was successfully used to analyse trace metal (cadmium, copper, lead and zinc) concentrations in seawater with very low detection limits.
- Generally, industrialized areas in Veraval and Mumbai coast is found to be contaminated with toxic metals such as Cd, Cu and Zn. Several sites in Vembanad Lake near Cochin were contaminated with Cd, Cu and Zn.
- Copper content from hotspots in Veraval and Tuticorin and Zn content in Ennore River mouth at Chennai near the North Chennai Thermal Power Station (NCTPS) was exceeding the EPA safe level given for aquatic organisms.
- Concentrations of Zn in seawater samples from industrialized areas of Chennai, Cochin, Mumbai and Vishakhapatnam were above the EEC guideline of 40 µg/L, while Cd concentrations in samples from industrialized areas of Veraval and Mumbai were above the EEC guideline of 2.5 µg/L.
- Concentrations of Pb in seawater samples from industrialized areas of Karwar were above the EEC guideline of 15 µg/L, while Cu concentrations in samples from industrialized areas of east and west coast were above the EEC guideline of 5 µg/L. However, the above observed concentrations were below the safe level given for marine organisms.
- Mean Cd concentrations in sediment samples from the industrialized areas of Vishakhapatnam, Cochin, Chennai, Veraval, Karwar, Mumbai and Tuticorin were above the Effect Range Low (ERL) concentration of 1.2 ppm prescribed by NOAA for Cadmium. Mean Cu concentrations in sediment samples from industrialized areas of Veraval and Mumbai were above the ERL concentration of 34 ppm.
- Mean Cd concentrations (ppm dry weight) in bivalves from Karwar and Vishakhapatnam and in finfishes from Vishakhapatnam were above the WHO safe limits of 9 ppm. Mean Pb concentrations (ppm dry weight) in bivalves from Tuticorin and finfishes from Cochin were above the WHO safe limits of 9 ppm.

PROJECT CODE	**FEM/03**
PROJECT TITLE	**Culture of seaweeds**
SCIENTISTS	**N. Kaliaperumal**, P. Kaladharan, Reeta Jayasankar and Gulshad Mohamed
CENTRES	Mandapam, Cochin, Calicut

MANDAPAM

- Data on the quantity of seaweeds exploited from the natural beds were collected from 11 seaweed landing centers in Tamil Nadu. Total landings were 2749 tonnes (dry weight) compared to 2821 tonnes (dry weight) during 2003 constituting 1618 tonnes of *Sargassum* spp, 148 tonnes of *Turbinaria* spp. and 701 tonnes of *Gelidiella acerosa*, 258 tonnes of *Gracilaria edulis* and 24 tonnes of *G.crassa*.
- Experimental culture of the agar yielding red seaweed *Gracilaria edulis* was carried out in the onshore condition in 1 ton capacity fiberglass tanks with running seawater and aeration system. The seed material was pretreated for 12 hours with Magnesium sulphate, Ferrous sulphate and Calcium nitrate separately at the concentration of 10, 10, 30 and 40 mg/l. The plants treated with 40 mg/l concentrations of Ferrous sulphate showed maximum increase in biomass of 26% after 42 days culture period.

CALICUT

- Culture of *G. corticata* was carried out at inter tidal region of Elathur using long line and growth and yield being monitored.

COCHIN

- Experimental farming of *Kappaphycus alvarezii* was carried out in the open sea off Narakkal with *Gelidiella acerosa*, *Ulva lactuca*, *Hypnea musciformis* and *Gracilaria edulis.* Growth rate of 16g/day was observed during the 60 days of culture period suggesting the possiblity of large scale culture along the west coast of India from October to March.
- Reduction in salinity as in the estuaries and barmouth is unfavourable for the growth of *Kappaphycus alvarezii.*
- To study the genetic variation of *Gracilaria verrucosa* species collected from Chennai, Quilon, and Chilka, some works were carried out and clear variation was observed among the species of different localities when amplified in a thermocycler with primer OPA 03 and OPA 13.
- Dry bits of brown seaweed *Sargassum wightii* were found capable of removing (adsorbing) 70% cadmium from seawater contaminated with 10 ppm concentration at an optimum pH of 5.0 with in 3 hours.
- The GABA (gama amino butyric acid) from red seaweed *Hypnea valentiae* was found capable of inducing fast settlement of bivalve larvae and the activity was comparable to the Sigma grade analogue.

PROJECT CODE	**FEM/04**
PROJECT TITLE	**Development of strategies for sea turtle and sea cucumber conservation**
SCIENTISTS	**M. Rajagopalan**, K. Vijayakumaran and P.S. Asha
CENTRES	Cochin, Visakhapatnam, Tuticorin

The monitoring of the phenomena of the mass nesting of olive ridley *Lepidochelys olivacea* along the Orissa coast revealed the nesting of 70,000 olive ridley during the 2003 season when compared to the failure of mass nesting during 2002 season. Ten thousand olive ridley were washed ashore during the 2003 season along the Orissa coast due to mortality in fishing gear.

- Field survey was conducted during February 2004 in collaboration with State Fisheries Department, Government of Orissa along the Orissa coast to assess the technical aspects of mortality of sea turtles in the gill nets
- The culture of the juveniles of *Holothuria scabra* in concrete tanks with flow-through system, fed with *Sargassum* at the rate of 10% of the body weight, was continued. The specimens showed an average weight of 97.01g with a growth rate of 0.67g/day towards the end of January 2003 and died due to skin disease out break.
- Four lakhs auricullariae produced on Jan 2003 showed 0.5 % settlement in 16 days. The survival and metamorphosis of the larvae were greatly affected by the ciliate infestation and high turbidity of the intake water due to the breakage of sea water filtering system. By the end of April, 46% of the initially settled juveniles survived, 8.3% at the end of June, 8% at the end of July and 7.6% at the end of August. The juveniles measuring >20mm showed a growth rate of 0.1695 mm/day in length and 0.0542g/day in weight towards the end of July and 0.052mm/day in length and 0.0308g/day in weight by the end of August. 7.6% of the initially settled juveniles (145 numbers) having an average length of 40mm and weighing 3.35g were released at a depth of 6m at the sea grass beds of Tuticorin Port area on 3.9.03.

One month old juveniles of hatchery produced *H. scabra*

- Experiments were conducted during June –July 03, to find out the effect of different feed combinations and the effect of an additional protein source on the growth of the juvenile *H. scabra* (>20mm). A combination of *Sargassum* powder mixed with fine and crushed coral sand and a commercial feed, "Algamac" at 2% level were found to promote growth of juveniles.
- Fifty thousand dipleurula of *H.scabra* were produced, from the spawning trial on Dec 2003. 1.6% of them survived after 14 days. Though most of them developed lipid spheres, lack of metamorphosis was noticed among the larvae due to the low ambient water temperature coupled with severe ciliate infestation.

PROJECT CODE	**FEM/05**
PROJECT TITLE	**Mariculture of live feed organisms**
SCIENTISTS	**Rani Mary George,** Reeta Jayasankar, Molly Varghese, Gulshad Mohamed
CENTRES	Chennai, Cochin, Calicut, Tuticorin, Mandapam

- Three sympatric sibling species of *Brchionus plicatillis* complex were isolated from the brackish waters of Chennai and maintained using suitable micro-algae as feed. Taxonomic studies of *Brachionus plicatillis* (Rotifera) complex from Chennai backwaters revealed

taxonomic characters constant enough to recognize three well defined morphological taxa.

- Studies revealed that the algal species influenced the morphological plasticity in size in the ultra minute *Brachionus rotundiformis*.
- At Chennai regular zooplankton samples were collected and isolation and culture of chaetognaths (*Sagitta spp*.) and ctenophores (*Pleurobrachia sp*.) were attempted as these form an important prey items for lobster larvae.
- The newly hatched mysis of ornamental crustacean *Stenopus hispidous* were reared to post larvae using a mixture of live feed organisms cultured at Calicut.
- Experiemnts carried out on the culture of *Chaetoceros* in different concentration of sodium bicarbonate with 50% enrichment of the medium showed that sodium bicarbonate influenced the chlorophyll content of *Chaetoceros* sp. at Cochin.

PROJECT CODE	**FEM/BIOD/01**
PROJECT TITLE	**Taxonomy of Marine Zooplankton**
SCIENTISTS	**T.S.Naomi**, Rani Mary George, and S.Jasmine
CENTRES	Chennai, Cochin and Karwar

- Creation of the database of the selected calanoid copepod family Pseudodiaptomidae comprising twenty-two species and one sub-species of the genus *Pseudodiaptomus* Herrick from the Indian EEZ is continued. Species profile of the common species of the family was constructed taking into account of the species specifications, characteristics, regional and environmental differences, taxonomic details, validity of synonyms, illustrations, figures and plates and stored.
- *Pseudodiaptomus serricaudatus* (T.Scott, 1894) and *P.annandalei* Sewell, 1919 were found to be the most common species of the genus occurring in the shallow areas of the west and east casts. Seasonality of their occurrence, maturity conditions, abundance and male-female ratios were recorded and photomicrographs of the species were taken in fresh condition.
- Scattered information, incomplete figures and illustrations of the species from various sources such as reports, research papers, monograph of the ancient and recent times were gathered and brought together.
- Dissected and microscopically examined these micro crustaceans to study the species-specific structural details, armature and articulations of the appendages to verify the identification of the available species from the east and west coasts.
- The biodiversity of the family was more in the east coast than in the west coast. Two species were found endemic to the northwestern part of the Bay of Bengal and four species to the Andaman – Nicobar waters.
- Seven species of the non-penaeid pelagic shrimp of the genus *Lucifer* of the super family Sergestoidea under Decapoda are present in the Indian waters, namely *L.hanseni* Nobili, 1905, *L.typus* H.Milne Edwards, 1837, *L.faxoni* Borradaile 1915, *L.orientalis* Hansen 1919, *L.penicillifer* Hansen 1919, *L.intermedius* Hansen 1919 and *L.chacei* Bowman 1967.

PHYSIOLOGY NUTRITION PATHOLOGY DIVISION

The Division implemented six in-house projects, five sponsored projects, and three NATP projects in the frontier areas of nutrition, pathology, physiology genetics and biotechnology. The Division Scientists also actively collaborated in the NATP sponsored – IVLP, ATIC, and pearl culture projects and DOD sponsored Marine mammals project, and in the in house project on organic farming of *Penaeus semisulcatus*, and selective breeding of pearl oysters. Besides the Division scientists were actively involved in organizing the M.F.Sc and Ph. D programmes of PGPM, besides supervising. The Division scientists published 21 Research papers in peer-reviewed journals; 11 papers have been published in impact journals and 1 has been accepted for publication in impact Journals. The scientists also made 6 presentations in symposia and conferences during the year. Four were published as popular articles and 14 papers have been published in Books/Bulletins.

Major achievements of the Division during the year were:

- Rights for production and marketing of the CMFRI PCR Duplex kit on commercial basis have been awarded to M/S. Microl Remedies, Hyderabad.
- A phytase producing *Bacillus* strain has been isolated from mangrove swamp and partial purification of the enzyme has been achieved.
- Weaning of juvenile mud crabs, *Scylla serrata* and portunids crab, *Portunus pelagicus* from fresh feed to dry pellet feed has been achieved.
- Technology for floating and sinking pellets for fish and crustacean feed using twin-screw extrusion process standardized.
- Phylogenetic relationships in four species of marine ornamenal fish *Amphiprion* established and putative sex-specific markers were developed in domesticated *A. sebae*.
- The Division scientists successfully guided 6 Ph. D. regular students/ SRF's in sponsored projects and 5 M. F. Sc dissertations during the reported period.
- Organized a 21-day Winter School on ' Recent Advances in Mariculture Genetics and Biotechnology ' sponsored by the Education Division of ICAR in which 21 university teachers and scientists from ICAR participated.
- Organised a Training Programme on "Histopathological Techniques in Disease Diagnosis" for officers of MPEDA and one private entrepreneur from 29-9-2003 to 10-10-2003 at CMFRI, Cochin.
- Disease Diagnostic Services and feed composition analysis, services have been rendered to aquafarmers through the ATIC, beside sale of feeds.

PROJECT CODE	**PNP/NUT/01**
PROJECT TITLE	**Development of cost-effective and eco-friendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions**
SCIENTISTS	**R. Paul Raj,** D. Kandasami, P. Vijayagopal, Imelda Joseph, PreethaPanikkar and Margaret Muthu Rethinam
CENTRES	Cochin, Mandapam and Madras

- The results of two experiments revealed the sets of protein requirement to be 350 g kg^{-1} diet for juveniles weighing > 2 g and 400 g kg^{-1} diet for post larvae of *Penaeus semisulcatus.*
- With a view to identifying suitable substitutes for partial or complete replacement of fishmeal in shrimp diets, a process for fermentation of a mixture of oilcakes and wheat flour along with soybean meal was developed. The amino acid profile of the diets incorporated with *B. coagulans* fermented ingredient at different levels showed considerable increase in glutamic acid, aspartic acid and serine. A increase in lysine and decrease in methionine levels were observed as compared to the control.
- Experiments were conducted to compare the nutritional profile of products derived by solid-state fermentation of a mixture of oil cakes. The optimum duration was determined based on the proximate composition of the products after each duration. Incubation for 120h was found to be ideal for industrial isolate with protein level of 48.82% (SD-0.73)%; while for the mangrove isolate it was 72 h with 47.71% (SD-0.56) and the control 44.17%. Since fungi were used, there was significant increase in crude fibre levels due to the synthesis of chitin (chitin level 2.12-2.88) by the fungi.
- Amino acid profile showed that the diets formulated with fungal fermented soyflour and oil cakes had higher levels of histidine, arginine, threonine, tyrosine, glycine and cystine and marginal decrease in methionine, and lysine and not much variation in leucine, isoleucine, phenylalanine and valine.
- A phytase producing bacterium was isolated from the sediments of mangrove area and its efficacy for phytase production studied.
- The crude enzyme extract prepared after 72 hours fermentation showed the highest phytase activity (1.24 x 10^3 phytase unit/ml). While the semi-purified enzyme after precipitation showed an activity of 2.189 X 103 PU/ml. The extracellular phytase production has been standardized and partial purification of the same achieved.
- Amylase production potential of *A. niger* strain $S_1$4 isolated from mangrove ecosystem was compared with *Aspergillus niger* strain 1248 from NCIM Pune using wheat bran as substrate. *A. niger* strain 1248 from NCIM produced 45u/gdfs amylase while the strain from mangrove ecosystem (Strain $S_1$4) produced 48.13u/gdfs under similar conditions.
- Acid protease production by *Aspergillus niger* strain $S_1$4 from mangrove ecosystem was studied using wheat bran as substrate. Optimization of duration was carried out in three replicates each for 2, 4, 6 and 8 days. Acid protease activity was studied at pH 2.7 and significant ($P<0.05$) peak activity (54.89 U $gdfs^{-1}$ and 49.50 U $gdfs^{6}$

for 2 x 10^6 and 40 x 10^6 spores 10gm of substrate^{-1} respectively) was obtained on 6th day.

- The process of extrusion technology was standardized for the preparation of floating (5 mm), slow- sinking (2 mm) and sinking pellets (1.0, 1.5, 2.0, 2.5mm) of ornamental fish feed. The hydrostability of sinking pellets ranged from 95% after 1 hr to 85% after 4 h. Proximate composition analysis showed crude protein: 43.57; crude fat: 5.96; crude ash: 11.46; crude fibre: 4.96 and nitrogen free extract: 33.04. The feeds have excellent acceptability to both marine and freshwater ornamental fish.
- Sea horses, *Hippocampus kuda*, are presently reared on live feed. Thin semi-moist diet particles containing 3-5% fish oil coated on to glass plates, after repeated trials were accepted. The fish took the feed falling from the plates more readily than those on the plate. A microbound particulate diet containing freeze-dried fishmeal was also accepted.
- Feeding experiments conducted on the lobster *Panulirus homarus* with three natural diets - squids (*Loligo spp.*), anchovies (*Stolephorus spp.)* and clams (*Meretrix casta*) for 49 days showed maximum weight gain and food conversion for the clam fed lobsters.
- Feeding experiments conducted for 60 days after weaning to test the efficacy of a formulated pellet feed (3 mm dia) for the lobster *P. homarus* with protein levels of approximately 40%. The duration of the weaning to the test feed ranged from 20 - 30 days. Analysis of the data indicated that the lobster fed the diet with clam meal as the protein base showed a higher conversion efficiency (44.63%) followed by fish meal (27.75%) and squid meal (23.91%). The results suggest that clam meal is a more suitable protein source than trash fish and squid meal as protein source in pellet feeds.

Feeding experiments with crab

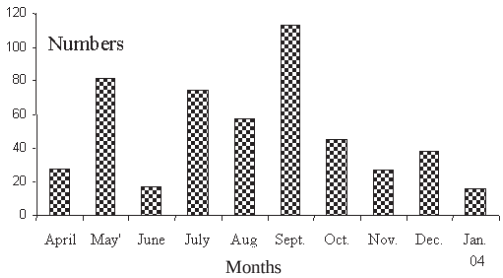
- Experiments on the swimming crab, *Portunus pelagicus* indicated that a feed containing clam meal was better as it promoted higher growth rate (weight gain: 60%), followed by squid meal (39%) and fishmeal (25%).

PROJECT CODE	**PNP/PAT/01**
PROJECT TITLE	**Disease monitoring and management in mariculture**
SCIENTISTS	**A.P. Lipton**, K.C.George, K.S.Sobhana N.K.Sanil, Margaret Muthu Rethinam and S.R. Krupesha Sharma
CENTRES	Vizhinjam, Madras, Cochin and Calicut

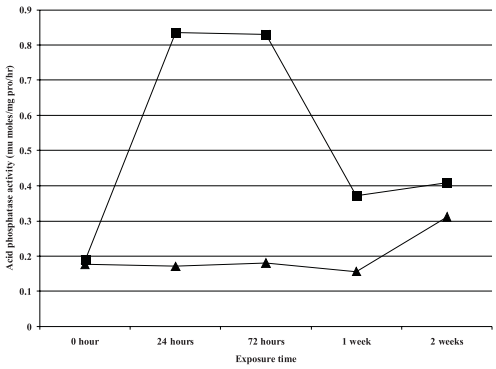
Diseases in fishes

The prevalence of microbial diseases in marine ornamental fishes in Vizhinjam aquarium was recorded throughout the year.

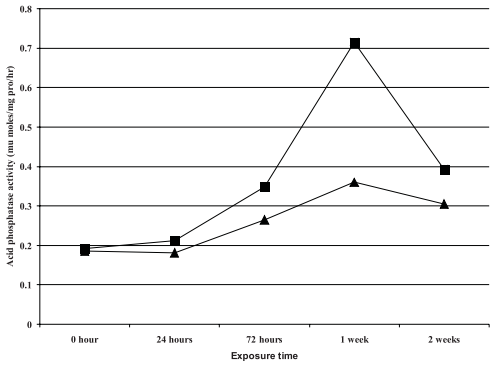
- Bacterial infections with symptoms such as hemorrhages on body surface, erythemia and fin and tail erosions were recorded in 498 cases in ornamental fishes.
- Detailed characterization of peduncle ulcer disease among clown fish revealed that the causative organism is *Flavobacterium* sp.



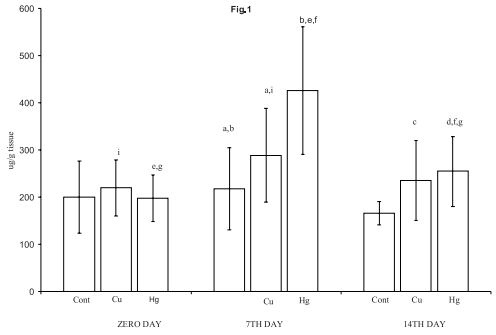
Pattern of fish mortality in marine aquarium at Vizhinjam



Acid phosphatase activity pattern in the mussel (*Perna virdis*) exposed to copper (■ copper; ▲ control)



Acid phosphatase activity pattern in the mussel (*P.virdis*) exposed to mercury (■ mercury; ▲ control)



Lysozyme activity pattern in the digestive gland of *Perna viridis* exposed to copper and mercury. Significant difference exists between bars with common letters (p<0.01). Vertical lines indicate standard deviation (n = 30). indicate standard deviation

Antibiotic sensitivity showed the following order of efficacy penicillin > chloramphenicol > OTC > gentamycin

- A necrotic disease in seahorse *Hippocampus kuda* was recorded and the causative organism was identified as a *Vibrio sp.* Antibiotic sensitivity test showed the following order of efficacy: chloramphenicol > oxytetracycline > gentamycin
- Infected marine ornamentals such as gobi, cleaner wrasse and butterfly fishes (fin and tail rot with body ulcerations) were successfully treated by 3 minutes dip daily with 250 ppm of choramphenicol for 3 days. Similarly, infected sucker fish (*Echineas* sp*)* were successfully treated with 150 ppm of chloramphenicol following the above protocol.
- Two strains of fungi, an invasive surface fungus from a diseased grouper, and an internal fungus isolated from moribund clown fish are being characterized.
- Viral nerval necrosis (VNN) was recorded in grouper by RT-PCR and histopathology.

Diseases in crustaceans

- Regular sampling from shrimp farms of Cochin area during the months from July to November did not have any prevalence of WSSV whereas from January onwards, new incidence of white spot virus infection and monodon baculo virus infection were noticed in farms of Vypeen area. Ultrastructural examination demonstrated white spot virus in the gill epithelial cells.
- *Penaeus indicus* collected from Narakkal had trophozoite stages of gregarine parasites in the intestine and gametocyst stages in the hindgut.
- Infections with *Ergasilus* sp. and *Dactylogyrus* sp. were recorded from the gills of *Liza parsia*.

Antibacterial activity of different solvent fractions of *Ulva* extract

- Antibacterial activity was detected in the methanol, ethanol and dichloromethane- methanol soluble fractions of *Ulva fasciata* with high activity against fish pathogens, clown fish *Vibrio* isolate CLY16J04, *Pseudomonas aeruginosa, Vibrio alginolyticus, V. fischeri, Micrococcus luteus* and *Staphylococcus aureus*.

Probiotic bacteria

- A total of 15 bacterial isolates from healthy shrimp gut were tested for antagonism against pathogenic bacteria, of which 6 strains showed antagonism. Two of these strains which showed good antagonism were tested for pathogenecity in postlarvae and juveniles and were found non-pathogenic indicating potential for use as gut probiotics in disease management. These strains when incorporated in feed and fed to postlarvae, showed significant improvement in growth and disease resistance compared to the control.

Purification of lysozyme from crystalline style of green mussel

- Lysozyme was purified from crystalline style homogenate of the green mussels, *Perna viridis* by gel filtration chromatography using

Sephadex G-75 (Sigma). The highest activity was obtained in 8th fraction with 44.8% recovery and 82.5 fold purification. SDS-PAGE with 15% resolving gel indicated a molecular weight of 16000 daltons.

PROJECT CODE	**PNP/PHY/01**
PROJECT TITLE	**Development of cost-effective low stress methods for live transport of fish and crustaceans**
SCIENTISTS	**R. Paul Raj,** D.C.V. Easterson, D. Noble, G Gopakumar and Imelda Joseph
CENTRES	Cochin, Tuticorin and Vizhinjam

- Experiments were conducted to identify a suitable anaesthetic/sedative to be used for transportation of marine ornamental damselfish. Oxygen consumption, output of CO_2, NH_3 and pH changes in the water during transportation of the fish at different intervals have been studied to evolve a suitable packing strategy for safe transport.
- Clove oil at a dose rate of 45ppm is found to be ideal anaesthetic/ sedative for the initial packing. Incorporation of 1ppm clove oil in the packing water facilitating maintenance of sedative effect during transport.
- Reduction in temperature and maintenance was achieved by placing one frozen ice gel sachet within the thermocole box of 0.03m^3 (40x25x30cm) and 2 sachets in (40x40x25cm) 0.04m^3 box in the plastic bag in which sedated fish is kept.
- Thermocole box of 0.03m^3 size can hold one plastic bag of 10-litre capacity containing 6 fishes, while 0.04m^3 can accommodate 2 plastic hags of 7.5 litre containing 6 fishes each. The cost of transportation has been reduced by 30% by using bigger box of 0.04m^3 size and thus better cost- effectiveness can be achieved.
- Protocol for ornamental damselfish transport for 24h has been standardized.
- The oxygen requirement of the seahorse *Hippocampus kuda* was determined in ambient and below ambient temperatures to find out possible reduction in metabolic energy utilization. The results show non-gravid fishes are suitable for transport by way of reducing the water temperature. However, temperature lower than 20ºC is not suitable. At 20ºC the energy requirements was only about 33.7% of the ambient (31ºC).

PROJECT CODE	**PNP/BIOT/01**
PROJECT TITLE	**Development of molecular and immuno-diagnostic kits for detection of finfish and shellfish pathogen**
SCIENTISTS	**P.C. Thomas,** K.C.George, K.S.Sobhana and N.K.Sanil
CENTRES	Cochin

A. Evaluation, release and commercialization of Duplex PCR kit for WSSV.

- The rapidity, cost effectiveness and reliability of duplex PCR kit for WSSV was confirmed through extensive trials and a user friendly Practical Manual of detailed protocols was prepared.

- Field isolates of the virus periodically screened to confirm their homology or presence of any mutant varieties.
- Diagnostic service to the hatcheries and farmers using the kit was provided.

B. Molecular genetic profiling and development of molecular and immuno diagnostics for bacterial pathogens

- Isolation and biochemical characterization of 12 field strains of *Aeromonas hydropila*, 8 strains of *Vibrio anguillarum* and 5 strains of *Vibrio parahaemolyticus* carried out.
- Highly virulent strain of *V. parahaemolyticus* (V13) was identified by pathogenecity evaluation of field strains.
- Polyclonal antisera against V13 raised, agglutination titre estimated and cross reactivity against other vibrios tested following optimization of an ELISA with V13 antiserum for detection of *V. parahaemolyticus*.
- DNA profiling of *Aeromonas hydrophila* field strains carried out through AP-)CR indicated very high genetic diversity. Absolute polymorphism with unique RAPD profile for each strain was observed. Species-specific amaplicons have been identified for use a molecular markers.
- Ultra-structure of *Aeromonas hydrophila* was resolved using transmission electron microscope (TEM) for locating antigenic sites in the next phase of study.

PROJECT CODE	**PNP/BIOT/02**
PROJECT TITLE	**Cryopreservation of marine fish spermatozoa**
SCIENTISTS	**D. Noble,** L. Krishnan and Grace Mathew
CENTRES	Cochin

- With a view to collecting cadaver sperms for cryopreservation 284 groupers in the weight range 3 to >18 kg were collected, but live sperms could not be obtained.
- Ornamental fishes have been screened for availability of milt. Milt could be collected successfully from damselfish. Efforts are on to identify the ideal extender-protectant combination for standardization of protocol for cryopreservation of damselfish spermatozoa.

PROJECT CODE	**PNP/GEN/01**
PROJECT TITLE	**Population genetic studies in threadfin breams and sardines**
SCIENTISTS	**P. Jayasankar** and U. Rajkumar
CENTRES	Cochin and Visakhapatnam

With a view to delineating any possible stock variations in threadfin breams and oil sardine from the east and the west coasts of India, truss morphometrics, and protein and DNA profiles of sample fishes were analysed.

Truss Network analysis:

- Truss landmarks of *Sardinella longiceps* from Cochin (115-215 mm TL), Chennai (120-155 mm TL) and Kakinada (73-215 mm TL) were

collected. Truss analysis was carried out separately for adults (>140 mm TL) and sub-adults (<140 mm TL). While there was clear vertical separation of clusters in sub-adults, the clusters were horizontally separated in adults.

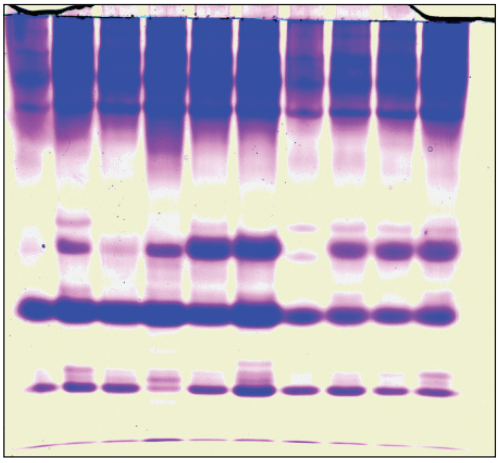
- Truss landmarks of *Nemipterus japonicus* and *N. mesoprion* from Cochin, Chennai, Kakinada Paradeep and Visakhapatnam were collected. In *Nemipterus japonicus*, the west coast sample was clearly demarcated from the east coast samples, indicating probable stock difference. On the other hand, in *N. mesoprion*, the clusters were overlapping, pointing to the phenotypic homogeneity of populations of this species. Results of sheared principal component analysis of truss landmarks of all the three species from different locations are depicted in the following figures.

Protein polymorphims:

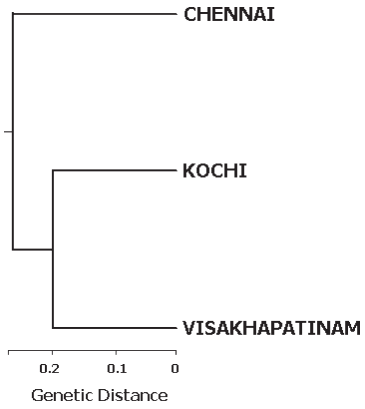
- Protein profiles were developed for threadfin breams and oil sardine after standardization of technique. Analysis of protein loci from oil sardine, *N. japonicus* and *N. mesoprion* is in progress.

RAPD polymorphisms:

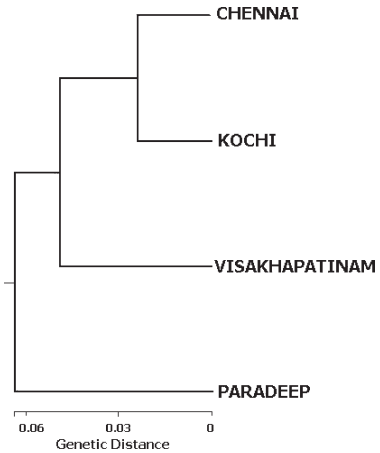
- Screened 12 arbitrary primers in a total of 70 oil sardine individuals from three populations, Chennai, Cochin and Visakhapatinam and short listed 4 primers for analysis of RAPD data based on the robustness and reproducibility of bands. Unweighted pair-group method with arithmetic (UPGMA) (Sneath and Sokal, 1973) contained in the NEIGHBOR program of PHYLIP ver 3.57c, based on Nei's (1978) genetic distance values was used. Apparently, the populations of oil sardine from Chennai and Cochin are well separated.
- Screened OPA 05, OPA 08, OPA 12, OPA 20, OPD 03, OPF 02, OPF 03, OPF 09, OPF 10 and OPF 15 from 80 individuals of *N. japonicus*, sampled from Chennai, Cochin, Paradeep and Visakhapatinam and short listed two primers for final analysis.



Protein profiles of 10 individuals of *N. japonicus* from Visakhapatnam



UPGMA dendrogram of oil sardine Populations from three locations



UPGMA dendrogram of *N. japonicus* from 4 locations

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

The Division has undertaken 6 in house and 4 NATP projects during the year 2003-2004. The division is involved in transfer of technology programmes, empowerment of fisherfolk and conservation of resources by conducting demonstrations, interactive meetings, trainings and campaigns. The Division is serving the fishermen community through the Agriculture Technology Information Centre (ATIC) by supply of technological inputs, products and services through the single-window delivery system.

PROJECT CODE	**SEE/PMS/01**
PROJECT TITLE	**Marketing and price structure of marine fisheries in India**
SCIENTISTS	**R.Sathiadhas,** R.Narayanakumar and N. Aswathy
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Vishakhapatnam.

- Analysis of price spread and monthly price fluctuations of different species of fishes at landing centre, wholesale and retail levels were done for the year 2003 for all maritime states and all India level.
- State-wise analysis of the monthly price fluctuations at landing centre level showed that the lowest price was recorded for oil sardines in almost all states and its price varied from Rs.3 to 17/kg in Kerala, Rs.8 to 12/kg in Andhra Pradesh, Rs.4 to 5/kg in Karnataka and Rs.2 to 3 /kg in Gujarat between months. The lowest average price for oil sardines was recorded in the month of January in Kerala (Rs.3/kg) and in Karnataka (Rs.4/kg). In Gujarat the lowest price was recorded for non penaeid prawns (Rs.1/kg) in the month of April.
- The highest average price was received for penaeid prawns (Rs108 to 242/kg) in Kerala, pomfrets (Rs.98 to 132/kg) in Karnataka, penaeid prawns (Rs.54 to 75/kg) in Andhrapradesh and lobsters in Gujarat (Rs.200 to 525/kg)
- At wholesale level the lowest average price was recorded in Gujarat for nonpenaeid prawns (Rs.2/kg) and the highest in Gujarat and Karnataka for pomfrets (Rs.148 to.210/kg).
- At retail level also pomfrets and seer fish received the highest price in almost all the states, whereas the lowest price varied for different species of fish across the states with oilsardines occupying the lowest in Kerala, silverbellies in Karnataka and nonpenaeid prawns in Gujarat. The price of pomfrets varied from Rs.100 to 227/kg in Karnataka, Rs.76 to 110/kg in A.P and Rs.160 to 267/kg in Gujarat .
- Fishermen earned comparatively better share of about 70% of the consumer rupee for species like sharks, peneaid prawns and seer fishes at all India level.
- Analysis of monthly price fluctuations of commercially important species in Kerala showed that at retail level oil sardines showed the highest CV (21%) followed by tunnies(16%) and the lowest fluctuations for mackerel. In Andhrapradesh the variability in retail fish price was less in pomfrets (9.54%) and highest for crabs (41.21%). In Gujarat the lowest variability was shown by snappers and the highest by horse mackerel. The low variability in retail prices of fishes indicate that their demand in the market is comparatively stable .

PROJECT CODE	**SEE/ECO/01**
PROJECT TITLE	**Economics of Marine Fishing operations**
SCIENTISTS	**R. Narayanakumar,** R. Sathiadhas and Aswathy, N.
CENTRES	Cochin, Veraval, Mumbai, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Mandapam, Chennai, Kakinada and Vishakhapatnam.

- Monitoring of collection of data on operational costs and earnings of different craft-gear combinations were continued in all the maritime states.
- Production function analysis of mechanised crafts in different states was also done.
- Analysis of economic performance of mechanized trawlers in different states showed that the average operating costs per trip varied from Rs.1084in Mahrashtra to Rs.7,088 in Kerala for single day fishing, Rs.20,373in Kerala to Rs.28,207 for multi-day fishing of 2-5 days and Rs.24,345 in Maharashtra to Rs. 52,467 in Andhra Pradesh,
- The net operating income varied from Rs.883 in Maharashtra to Rs.7,063 in Andhra Pradesh for singleday, Rs.8,454 in Kerala to Rs.35,276 in Maharashtra for multi-day units (2-5days), Rs. 9,576 in Kerala to Rs.22,033 in Maharashtra for multiday units of above 6days.
- The operating ratios were found lowest for single day fishing in Kerala (0.62), and Andhrapradesh (0.41) comparing to mulitday fishing units..
- For the motorized category the net operating income per trip was maximum for dolnetters in Gujarat (Rs.23, 884) and minimum for gillnetters (Rs.351) in Goa. In the non-mechanized category the net operating income varied from Rs.34 in Goa to Rs.2,560 per trip in Maharashtra for shore seines.
- The results of the functional analysis using a linear regression model in Kerala &Andhrapradesh showed that among the different variables, labour and fuel costs had significant positive influence on gross income.

PROJECT CODE	**SEE/TOT/01**
PROJECT TITLE	**Evaluation of transfer of technology programmes in marine fisheries**
SCIENTISTS	**Sheela Immanuel,** R.Narayanakumar, C.Ramachandran, S.Ashaletha and V.P.Vipinkumar
CENTRES	Cochin, Mangalore, Tuticorin, Kakinada, Orissa

- Out of the 15 Transfer of technology programmes identified in Tamil Nadu, Kerala, Karnataka, Andhra, Maharashtra and Orissa, 10 were implemented by State/ Central government organisations and 5 by NGOs.
- All the identified TOT programmes met the set goals and objectives. Majority (70 to 85 %) stated that the programmes are techno- socio – economically acceptable and consistent at farm level. Under the artificial reef programme, 15 % experienced social problems. Average annual income increased from 30 % under value addition in Tamil Nadu to 120 % in shrimp farming in Andhra Pradesh. Average indebtedness among beneficiaries reduced 10 to 20 % in all the programmes.

- Fishermen under the artificial reef programme realised an yield increase of 40%. Nearly 80% of the beneficiaries under oyster farming, crab culture, introduction of ice box, blow fly control, community peeling shed and shrimp farming reported that they gained knowledge about the new practices and 60 % had shifted from the traditional to scientific practice. Efficiency in prawn peeling was increased from 20 to 40 % due to the training under the community peeling shed programme in Kerala.
- In all the programmes 20 to 35 % reported an increased level of savings from 5- 10 %. About 20 % reported that their family members also got employment in the case of mussel, shrimp and crab culture. Overall 85 % are of the opinion that the TOT programmes are more beneficial than other rural development programmes because this helped them to have close linkage with the researchers / extension personnel and other officials of the development departments.

PROJECT CODE	**SEE / ITK / 01**
PROJECT TITLE	**Indigenous Knowledge Systems and Community based Resource Management in Marine Fisheries**
SCIENTISTS	**S. Ashaletha,** C.Ramachandran, R. Narayanakumar and Vipin Kumar,V.P
CENTRES	Cochin, Tuticorin, Chennai, Mangalore, Karwar and Kakinada

The study was taken up in Kerala, Karnataka, Tamilnadu and Andhra Pradesh. The survey work was accomplished after translating the schedules into Malayalam, Kannada, Tamil and Telugu. The recording of ITKs are completed. Based on a preliminary analysis, the ITKs were classified into five categories viz;1) Craft and gear making/maintenance, 2) Harvesting, 3) Post harvest, 4) Medicinal values and 5)Beliefs and customs. Some of the significant findings on ITK's are:

- Craft and gear making

Nandu valai¸ *Kalangatti valai*, Star (anchor for nets), *Thallumadi* etc of Tamilnadu, Outer rigger canoe in Karwar, *netholy valai*¸ *mathivalai* etc of Kerala. With regard to craft and gear making more than 20 types of locally made craft and gears have been identified so far .

- Maintenance of craft and gear

Smearing Cashew oil, sardine oil, *kari* oil, sap of *marotti* plant etc on boats, different techniques using rice porridge (Kerala), bampu bark solution (Karnataka) etc on nets.

- Harvesting

Special to and fro moving technique for catching fish from rocky areas(Kerala), Diving using locally made aluminum flippers& fish trapping lure of Tamilnadu, shoal identification observing halo around the moon, water movement, clarity and smell of water, sky colour change etc.

- Post harvest

Papads prepared from ray fishes, (Tamilnadu) *meen aval* (Kerala), curing fish under moon, smearing beach sand and digging under beach sand for preserving, smoking, salting in wooden boxes etc (Andhra Pradesh) -20 techniques were documented so far.

Traditional outer rigger canoe of Karwar

- Medicinal values

More than 18 local practices of consuming different fishes for curing many illnesses like cough, arthritis, stomach disorder, better lactation of mothers, increasing longevity are recorded

- Beliefs and customs

About 10 items were observed on beliefs and customs such as ban on fishing on days of lunar eclipse, death of somebody in the village, and socio- religious functions.

PROJECT CODE	**SEE / TOT / 02**
PROJECT TITLE	**Alternative Livelihood options for Fisherfolk Through Crab Fattening**
SCIENTISTS	**Ashaletha, S** and Sheela Immanuel
CENTRES	Mangalore and Karwar

- Two training programmes were arranged in Mangalore and Kundapura in association with KVK of UAS, Bangalore, BFDA and State Department of Fisheries, Mangalore. Two ponds were identified in Karnataka for Crab fattening. Seeds weighing 200 to 500 g were stocked in the ponds during the month of December and trash fish was given as feed. Non-availability of seeds and vide spread disease problems are the major constraints experienced by the farmers.
- The results indicated the need for identification of appropriate resource oriented location specific programmes in the first phase to implement any demonstration project. Therefore, the project objective has been restricted on the need assessment and livelihood analysis of fisherfolk for the coastal states of Karnataka, Kerala, Tamil Nadu and Andhra Pradesh to identify the aspirations of fisherfolk and prioritise appropriate location specific interventions for technological empowerment.

Training programme on crab fattening for farmers

PROJECT CODE	**SEE / TOT / 03**
PROJECT TITLE	**Dissemination of Mussel farming technology through Self Help Groups of Karnataka, Goa and Maharashtra coastal belts**
SCIENTISTS	**Vipinkumar.V.P,** Asokan.P.K and Ramachandran.C
CENTRES	Karwar

- Two training and demonstration programmes in two sites in Karwar were undertaken, one for *raft culture* in open sea in Majali of Dandebag and one for *rack culture* in Sunkeri of Kali estuary. The training was imparted to 45 beneficiaries of three Self Help Groups each possessing 15 members in 2 sites separately comprising a total of 90 beneficiaries. At Majali in open sea, a 5 x 5 metre raft and at Sunkeri of Kali estuary, a 5 x 5 metre rack were constructed for mussel farming. The harvest results in Sunkeri gave an average of 12. 2 kg mussel per metre rope. The growth parameters indicated that seed mussel having an average length 28.41 mm weighing 2.18g grew to a size of 78 mm weighing 29.9 g within a period of 150 days registering an average monthly growth rate of 9.91mm in length.
- In Bhatkal, 4 Self Help Groups of 15 members each exclusively of women fisherfolk mobilised under the NGO, ' *Snehakunja* '

Open sea mussel farming in Majali of Karwar

Training & demonstration on
Open Sea Mussel culture at Majali.

comprising a total of 60 participants of women fisherfolk were trained on mussel farming. They initiated a trial in 5 x 6 metre rack mussel culture by long line method in Mundalli river of Bhatkal estuary. The harvest results in Bhatkal gave an average of 13. 4 kg mussel per metre rope. The growth parameters indicated that seed mussel having an average length of 33.2 mm weighing 3.26 g grew to a size of 70.6 mm weighing 18.3 g within period of 83 days registering an average monthly growth rate of 12.4 mm in length.

- With the assistance of ' Snehakunja ' NGO, training on mussel culture was done in Gabitwada village of Ankola taluk for 3 women Self Help Groups of 15 members each comprising a total of 45 participants. Similarly women's Self Help Groups mobilised under *Kadamba charity* (NGO) were trained for mussel farming in Aversa and Karwar. In Aversa, a total of 84 women members representing 6 SHG's and in Karwar, 69 women members representing 4 SHG's participated in the training.

SPONSORED PROJECTS

PROJECT TITLE	**Predictive Modeling in Marine Fisheries of South West Coast of India**
SCIENTISTS	**M. Srinath,** T.V. Sathianandan, Somy Kuriakose and Mini, K.G
CENTRES	Cochin

- Periodograms were computed for the time series data on quarter-wise landings of 18 species groups in Kerala during 1960-2000 and also for the total catch. Seasonal and cyclical components were identified and estimated along with the percentage of variation explained by these components.
- Non-Seasonal ARIMA models were identified and estimated for these series after removing the cyclical and seasonal components from each of the time series. Selection of suitable models were carried out based on AIC and SBC criteria. Modeling non-seasonal ARIMA were also attempted after logarithmic transformation.
- Seasonal ARIMA models were fitted to the time series on quarter wise landings for 13 species groups after standardization for zero mean and unit variance.

PROJECT CODE	**WorldFish Center, Penang, Malaysia**
PROJECT TITLE	**Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor household in Asia (ADB-RETA 5945)**
SCIENTISTS	**N.G.K. Pillai**
CENTRES	CMFRI, Cochin (Co-operating Centre)

- Catalogued the existing and pipeline mariculture technologies, fishing practices and post-harvest technologies in India. The documented technologies were prioritized to help the rural poor in poverty alleviation and the final report on Component-I "Aquaculture Technologies and Fishing Practices in India" was submitted to the WorldFish Center, Penang. The report was presented and discussed in a National Workshop conducted on 29th & 30th January 2004 at NCAP, New Delhi. Suggestions/recommendations made by the experts in the workshop were incorporated and finalized the report. A paper entitled 'Marine fishing practices and coastal aquaculture technologies in India' has been published.

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Investigations on the effect of bottom trawling on the benthic fauna off Mangalore coast**
SCIENTISTS	**P.U.Zacharia,** C. Muthiah, P. K. Krishnakumar
CENTRE	Mangalore

Significant increase was observed in Total Suspended Solids (TSS) after trawling at all depth stations. Significant variations were noticed in D.O. and Chlorophyll *a* before and after trawling at all depths. Higher values were observed at the near shore waters (10, 20 m). Significant changes were observed after trawling in organic carbon in sediment.Percentage of clay was found reduced at all depths after trawling.

Targeted fish catch at 10 m depth by Single Day Fishery in trawl off Mangalore

The total biomass of macro benthos increased at 10 m, 20 m, 30 m, 40 m and 50 m depth after trawling. There was decrease in biomass of most of the groups at 10 m.

The dominant groups among macro benthos were bivalves and polycheates, their numerical density increasing at all depths after trawling.

Discards formed 44.2% of all fish catch in SDF but only 10.6% in MDF. CPUE of discard was less in post-monsoon than in pre-monsoon season.

Targets varied from 37.9% in SDF to 59.7% in MDF. Non-targets were 62.1% in SDF and 40.3% in MDF. Juveniles formed 7.85% of total catch in MDF and 13.8% in SDF.

The biodiversity indices based on abundance in macro benthos showed reduction at 10m and 20 m depth stations off Mangalore. Similarly biodiversity indices based on abundance of meio benthos has also recorded significant reduction at most of the stations after trawling.

Impact of trawling (before and after) on the biodiversity indices of meiofaunaform 10-50 m depth stations off Mangalore

Depth (m)	Trawling	Species (s)	Abundance (n)	Richness (d)	Evenness (J')	Shannon (H')	Simpson
10	Before	8*	31647	0.68	0.34	0.70	0.33
	After	8	42934	0.66	0.24	0.49	0.21
20	Before	8	51467	0.65	0.23	0.48	0.22
	After	8	55512	0.64	0.18	0.38	0.16
30	Before	8	69551	0.63	0.24	0.49	0.22
	After	8	59331	0.64	0.17	0.38	0.15
40	Before	8	44249	0.65	0.58	1.21	0.64
	After	8	40551	0.66	0.58	1.20	0.64
50	Before	8	31323	0.68	0.60	1.26	0.65
	After	8	27616	0.68	0.62	1.28	.067

* Meiofauna was represented by 8 species at all depths before and after trawling

Generally biodiversity indices such as species richness, evenness, Shannon Weiner index and Simpson index showed reduction after trawling from 10 to 30 m depth stations.

Fishing in shallow waters produce more discards including juveniles as compared to deeper waters.

Biodiversity impact studies from experimental trawling showed that non target species are caught in large numbers thus indicating fishing pressure on these groups off 10m and 50m depth.

FUNDING AGENCY **AP Cess Fund**
PROJECT TITLE **Increasing fish production through Artificial Fish Habitats (AFH)**
SCIENTISTS **E.Vivekanandan,** G. Mohanraj
CENTRE Chennai

The project funded by ICAR – AP Cess Fund was initiated during 2001 and is continuing.

Three different kind of Artificial Fish Habitats (AFH) namely HDPE structure (1 No.), Ferro cement modules (50 nos) and concrete well rings (100 nos) were installed at Chinnandikuppam village, south off

Chennai in January 2003.

- A total of 2694 kg of fish worth Rs. 1,11,197/- was realised from this area, the major fishes caught being snappers, carangids, breams and pomocentrids. The gears used were hooks and line and gill net. Studies are continued to compare the production between AFH and non- AFH areas.

Artificial Fish Aggregating Device at Chennai

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Development of Acoustic techniques for fish and DSL biomass Estimation**
SCIENTISTS	**N.G.Menon**
CENTRE	Cochin

Two cruises (200 and 218) were conducted for Target Strength (TS) studies along the south west coast of India with the objectives of measuring target values of commercially exploited marine fishes like mackerel, sardine , ribbon fishes etc and of the major DSL components like pelagic shrimps and myctophids. Gears like IKMT and commercial trawl were operated for the purpose .

The collection and maintenance of DSL organisms met with limited success due to the lack a proper gear and of a standardised technology for keeping the deep-sea organisms live for taking the TS measurements. The studies indicate that for further TS studies, a modified version of Krill net (Try Net) or a modified commercial trawl (tucker trawl with closing mechanism) with appropriate mesh size to catch the DSL organisms live is required.

FUNDING AGENCY	**Marine Products Export Development Authority**
PROJECT TITLE	**Participatory management and conservation of lobster resources along the southwest coast of India**
SCIENTISTS	**E.V.Radhakrishnan**
CENTRE	Cochin

During the year one workshop at New Ferry Wharf, Mumbai (29.4.2004) and three workshops, one each at Veraval (1.5.2004), Mangrol (1.5.2004) and Porbander (2.5.2004) in Gujarat were held. Fishermen, mechanised boat owner's association, traders, exporters and representatives from Central and State Government Organisations participated in the meeting and expressed their views on the lobster conservation programme. At Mumbai, mechanised boat owner's association demanded subsidy from Government for releasing back the egg bearing lobsters. In Gujarat, the stakeholders were convinced on the need for regulation and conservation measures as the fishery was drastically affected.

Various activities were:

- Pamphlets and lobster conservation stickers in Marathi were released in the workshop at Mumbai.
- Rallies on lobster conservation were held at Veraval, Mangrol and

Participatory meeting on lobster conservation at Porbandhar, Gujarat

'V' Marking of berried lobsters

Releasing of berried lobsters

Porbander.

- Lobster conservation posters, pamphlets and stickers in Gujarati were handed over to the traders, exporters and fishermen association at Veraval, Mangrol and Porbander.
- 108 egg bearing lobsters procured from fishermen were released back after 'V' notching at Kadiyapatnam, Kanyakumari District. Two lobsters were recaught and voluntarily released by fishermen.
- 45 CIFT designed lobster traps were freely distributed to Enayam lobster fishermen. Wide publicity given in TV and news papers. Operation of traps given to Kadiyapatnam fishermen was monitored.
- Slides on lobster conservation slogans are continuously projected in two local movie theatres.
- 10,000 pamphlets, 5,000 lobster conservation posters and 2,000 stickers were printed and distributed in the lobster fishing villages along the Southwest and Southeast coasts.
- The lobster conservation programmes were included in a paper presented in the 7th International Conference on Lobster Biology and Management, held at Hobart, Australia, in February 2004.

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**Reproductive dynamics of penaeid prawns off Mumbai waters**
SCIENTISTS	**V.D.Deshmukh**
CENTRE	Mumbai

- Two species of shrimps *Metapenaeus moyebi* and *Parapenaeopsis cornuta*, not recorded earlier in Maharashtra, were found to form inshore fishery in Rajpuri creek and in the trawl fishery at Harnai, respectively. In addition, *Penaeus indicus* and *M. dobsoni* were also noticed at Rajpuri and Harnai.
- Reproductive studies on all the species have been carried out for size at maturity, spawning season and periodicity, sex ratio and fecundity.
- In order to find out the number and the biomass of recruits of prawns, length-based cohort analysis was carried out for which VBGF growth parameters were estimated, using FISAT programme for all the species.

Von Bertalanffy growth parameters of penaeid prawns were estimated as follows:

Species	Sex	Maximum length in mm	L∞ in mm	K (annual)	Length of recruitment	Age of Recruitment (months)
Fenneropenaeus merguiensis	M	193	200	1.8	43	1.6
	F	238	246	1.9	48	1.4
Solenocera crassicornis	M	96	105	1.5	33	3.0
	F	128	142	1.6	23	1.3
Metapenaeus affinis	M	158	179	1.7	33	1.4
	F	183	202	1.7	33	1.3
Parapenaeopsis stylifera	M	108	115	1.8	33	2.2
	F	143	152	1.8	28	1.4
Metapenaeus monoceros	M	182	200	1.7	38	1.4
	F	211	236	1.7	38	1.2
Parapenaeopsis sculptilis	M	123	136	1.7	33	1.9
	F	166	174	1.6	33	1.6
Metapenaeus brevicornis	M	113	129.4	1.58	38	2.6
	F	163	172	1.49	38	2.0

FUNDING AGENCY **Department of Fisheries, Government of Kerala.**
PROJECT TITLE **Development of artificial reefs off Kerala coast.**
SCIENTISTS **K.K.Philippose**
CENTRE Calicut

- An artificial reef of 10,000 sq.m was installed off Muttom at a depth of 15 m using 150 concrete modules. Reef was developed around an existing sunken ship as per the interest of the fishermen. Enrichment materials like coconut leaves and stumps were deposited in the reef area during May 2003 to increase the productivity of the area. 120 fishermen were involved in developing the reef.
- Observation on the fishery commenced from the month of September 2003 onwards.Lobster catches from the reef area was estimated to be 0.8 tonne from September to December 2003. Total fish catch from the reef area was estimated to be 723 tonnes from September to December 2003. Cuttlefish and squid landings were observed from the reef area from October to December 2003.

FUNDING AGENCY **Department of Fisheries, Government of Kerala**
PROJECT TITLE **Survey, assessment and breeding of the marine ornamental fishes along Malabar coast**
SCIENTISTS **K.K.Philippose**
CENTRE Calicut

- Survey and assessment of marine ornamental fishes were carried out at Kozhikode, Thikkody, Chombal and Dharmadom centres along the North Kerala coast.
- 114 species of marine ornamental fishes were collected, identified and preserved.
- Conditioning technologies were developed for 68 species in the Calicut Marine Research Aquarium.

- Four training programmes were conducted in association with TTC of CMFRI for popularizing ornamental fish culture.
- Seasonal abundance and distribution of 21 species of commercially important ornamental fishes were studied.

PROJECT CODE	**ICAR - AP CESS**
PROJECT TITLE	**Development of sea farming technology for the whelk, Babylonia spp.**
SCIENTISTS	**K. K. Appukuttan** and P. Laxmilatha
CENTRES	Cochin

- During 2002-2003, the whelk contributed 52.8% of total gastropod landing at Neendakara and Sakthikulangara. Other gastropods landed are *Bursa* spp., *Tibia* spp and *Murex* spp. There was targeted fishery for *Babylonia* observed during April to June. The fishery of *Babylonia spirata* represented the size range of 34 - 44mm while *B.zeylanica* contributed 40-48mm.
- The catch data were analyzed for the catch and effort, species composition, length frequency. Annual landing of whelk during 2001 was 295 tonnes. It increased to 442t in 2002, whereas it decreased to 327t in 2003. The highest mean CPUE (16.4kg) was found in May for these 3 years. The mean CPUE for these years is 7.5kg. During the peak fishing season (April to June), around 40 boats do targeted fishing mainly for *B. zeylanica*, because of its higher demand for export. The CPUE for these units was 400kg. Though the overall landing has increased from the 2001 to 2002, the catch rate has decreased during 2003. This is attributed to the enhanced effort.

Monthly trawl landing at Sakthikulangara- Neendakara harbour for the year 2003

Month	Total trawl landing (t)	Gastropod (t)	Babylonia (t)	Percentage of *Babylonia* in gastropods	CPUE (kg)
JAN	1028	26	9.9	38.3	3.8
FEB	2569	26	7.0	26.9	1.4
MAR	777	32	9.7	30.5	2.7
APR	2430	46	25.1	54.1	3.6
MAY	2015	205	170.6	83.3	26.1
JUN	1523	94	74.0	78.8	22.2
JUL	-	-	-	-	-
AUG	10273	80	17.8	22.3	1.2
SEPT	1569	12	2.7	22.2	0.5
OCT	7444	21	-	-	-
NOV	908	7	-	-	-
DEC	2635	20	9.9	48.3	2.5

- Data on by-catch composition in the shrimp trawlers, in which whelk are caught, indicated that during October undersized and non edible fishes formed the major portion of the by-catch while *squilla* contributed the bulk during November and December 2003.
- Acclimatized brood stock spawned in the hatchery within 6-7 days of stocking. Average size of the spawners was 36mm. The peak spawning period was September to January. The larvae hatched out

from the capsules on the 7th day. Settlement of the planktonic larvae was between 15th to 16th days with 60% survival rate.

- Different algal species were tried as food of larvae. Poor growth and heavy larval mortality occurred when fed with *Tetraselmis* sp. and *Nannochloropsis* sp. Pure cultures of *Isochrysis* and *Chaetoceros* were provided to the larvae up to the 17th day with good settlement. The larvae were fed at the rate of 7000 cells/ml/hr.
- Metamorphosis of the larvae completed within 16-18 days and the survival rate after settlement was 70%. During the settlement stage, they attained 800-1000µ shell length. Shrimp and squid meat were found to be good feed for the juveniles.
- The larvae were reared in different salinities ranging from 5 to 50‰. It is observed that in the 5, 10, 15 and 20 salinities, the larvae did not survive where as growth and maximum percentage of settlement (56%) obtained at 30‰ salinity. The settlement percentage was very low at 40‰ salinity (14%) and no settlement was observed in 45‰ till 17th day. Complete mortality recorded in 50‰ salinity. Maximum settlement was observed in 30‰ with a pH ranging between 8.1-8.3 and the temperature 26-28^0 C.
- The average shell length of the juveniles of *B. spirata* increased from 895.4µ to 2.43 mm on the 60th day after settlement. The juveniles reared in hatchery attained 30mm length and 5.3gm weight in 9 months. The growth rate of juvenile was found to be 0.06 mm/day.

Spawning of *Babylonia spirata*

Sl. No.	Stages	Development after release of capsule	Size (µm)
1	2-cell stage	2h	300
2	4-cell stage	3h	305
3	Morula	24h	315
4	Veliger move to the tip of the capsule and are released through apical aperture	7th day	446 (length) 313 (width)
5	Crawling and active search for feed, turn carnivorous.	16-18th day	737 (length) 621 (width)
6	Velum cast off, radula and digestive tract develops, mucus secretion begins	Post settlement	781 (length) 680 (width)

PROJECT CODE **AP Cess Fund**

PROJECT TITLE **Application of trophic modelling and MSVPA to formulate management options for the multigear marine fisheries of Karnataka**

SCIENTISTS **K.S. Mohamed,** P.U. Zacharia, C. Muthiah, P. Rohit, P.K. Krishnakumar

CENTRES Mangalore

- A trophic model of the Arabian Sea ecosystem off Karnataka was constructed using the ECOPATH with ECOSIM (EwE) software
- The Karnataka model encompassed an area of 27,000 km^2 and had

24 functional ecological groups. These groups ranged from apex predators like marine mammals, sharks and tunas to micro zooplankton and detritus.

- The total system throughput, which is the sum of all flows in the system, was estimated as 11522 t/ km²/ year. This estimate is consistent with tropical marine ecosystems with high turnover.
- The gross efficiency of the ecosystem (catch/ net primary production) was estimated as 0.0016, which indicates an ecosystem, which is in the process of achieving full maturity.
- The Arabian Sea ecosystem of Karnataka has a relatively low ascendancy (33%) when compared to some other shelf systems. The system overhead is approximately 67%. This suggests that the Arabian Sea ecosystem of Karnataka has significant strength in reserve and can either be resistant or resilient to perturbations with the capability to bounce back quickly to original levels. A trophic flow diagram was constructed such that boxes representing organisms low in the food web are placed in the lower part of the graph, along with the plants, while the boxes representing organisms high in the food web are put higher up. The boxes were connected by means of trophic flows.
- Simulation exercises using ECOSIM with a 17% per annum effort increase over a period of 10 years in all fleets indicated the following.

  a. The total catch in MDF and its value show only a marginal increase, indicating that increase in effort from the present level for MDF is not warranted.

  b. The yields and biomass of benthic omnivores (mainly flatfishes and Squilla) and medium benthic carnivores (mainly sciaenids) are liable to decline drastically in SDF and, therefore, effort increase in SDF is not recommended.

  c. The total catch and value in PS, which show a dip during the first 5 years, are likely to return to the present level within 10 years. Considering these results, an effort increase in PS fleet is not recommended.

  d. The total catch and value of the fishery in DGN are prone to decrease and therefore, an effort increase in DGN fleet is not recommended.

  e. The simulation results for H&L fleet shows that the yields of large benthic carnivores (mainly *Pristipomoides filamentosus* and rock cods) can be markedly improved by increasing the effort. However, the total value does not show much increase, therefore, a recommendation for increase in effort can be made only when there is a substantial increase in the price structure of *P. filamentosus* and rock cods.

  f. The total catch and value in AS fleet does not show much change, and therefore, an increase in effort for the AS fleet cannot be recommended.

Ecosim simulation of yields of important resources in Purse seine fleet along Karnataka coast with varying effort regimes over a 10-year time scale

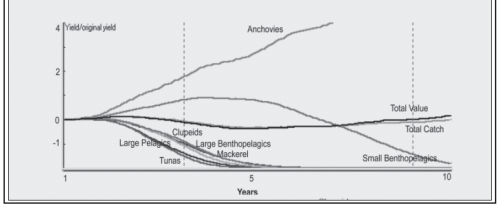


Table: System statistics - Karnataka Arabian Sea Trophic Model

Parameter	Value	Units
Sum of all consumption	5421.86	t/km²/year
Sum of all exports	904.36	t/km²/year
Sum of all respiratory flows	3190.641	t/km²/year
Sum of all flows into detritus	2005.517	t/km²/year
Total system throughput	11522	t/km²/year
Sum of all production	5243	t/km²/year
Mean trophic level of the catch	3.04	
Gross efficiency (catch/net p.p.)	0.001605	
Calculated total net primary production	4095	t/km²/year
Total primary production/total respiration	1.283	
Net system production	904.359	t/km²/year
Total primary production/total biomass	29.999	
Total biomass/total throughput	0.012	
Total biomass (excluding detritus)	136.505	t/km²
Total catches	6.573	t/km²/year
Connectance Index	0.382	
System Omnivory Index	0.299	

PROJECT CODE **ICAR Revolving Fund**
PROJECT TITLE **Commercial Production of Cultured Pearls adopting onshore culture technology**
SCIENTISTS **A.C.C. Victor**
CENTRES Tuticorin

- Currently a stock of 1, 39, 280 numbers of pearl oysters of different sizes are under rearing in the pearl farm.
- An amount of Rs.90, 000/- was realized through the training charges for the two batches of training conducted.
- A total of Rs.8, 89, 686/- has been realized through sale of cultured pearls.
- A total of Rs.11, 31, 772/- has been realized through sale of oysters/ nucleated oysters.
- A stock of 31 nos. (A): 1,047 (B) and 7,368 (C grade) commercial grade pearls valued at Rs.5, 61, 014/- is currently available under the project.
- Pearl farmers of Mundalmunai Pearl culture society with the financial support from M.S. Swaminathan Research Foundation and technical guidance given by CMFRI, started pearl farming and harvested pearls from their pearl farms in Gulf of Mannar from June 5th 2003.

PROJECT CODE **Department of Ocean Development**
PROJECT TITLE **Farming and pearl production in the black lip pearl oyster *Pinctada margaritifera* in Andaman and Nicobar Islands.**
SCIENTISTS **M.J. Modayil,** K.K.Appukuttan, T.S. Velayudhan, K.S. Mohammed, V. Kripa, S. Dharmaraj, I. Jagadis, and B. Ignatius
CENTRES Port Blair, Andaman and Nicobar Islands

- Project initiated with the recruitment of 2 RAs and 3 SRFs and purchase of necessary equipments.

- Project staff were given training in pearl oyster hatchery and farm work at Tuticorin and Cochin
- The proposal identifying the Department of Fisheries A&N Islands as the nodal agency for implementing the construction work at the project site has been sent to the Development Commissioner A&N Islands.

FUNDING AGENCY	**ICAR (AP CESS funded project)**
PROJECT TITLE	**Studies on the incidence of toxic principles and parasites in seafoods.**
SCIENTISTS	**C.P.Gopinathan**, V.Kripa
CENTRE	Cochin
COLLABORATIVE AGENCY	CIFT, Cochin.

Occurrence of algal blooms, both toxic and non-toxic has been regularly reported from the coastal waters of Kerala. This project was aimed to collect detailed information on the locations and seasonality of harmful algal blooms and the incidence of PSP and DSP toxins in the bivalves of this region for providing advance warming to avoid shellfish poisoning. A data base on the hydrographic parameters in relation to algal blooms at selected stations which are sites of frequent blooms in the past years was prepared. The salient features of the study are mentioned below:

- Harmful algal blooms often follow a period of intense rainfall and run off which increase the nutrient content, possibly enclosing a patch of chemically and physically modified surface layer, favourable for the rapid growth of harmful microalgae followed by a period of intense sunlight.
- *Hornellia marina* regularly blooms along the Calicut coast soon after south west monsoon in September-October and cause mortality of fishes due to asphyxiation.
- Bloom of the dinoflagellate *Noctiluca miliaris* was observed in many sites along the Kerala coast associated with the mortality of the fauna.
- Dinoflagellates dominated the samples from Vizhinjam and diatoms from Thalassery. The DSP producing dinoflagellate *Dinophysis* spp was present in most of the monthly samples from Vizhinjam, but never in harmful proportions.
- *Crassostrea madrasensis* from the farms at Dalavapuram, Quilon were found to be infected with the polychaete *Polydora* spp. causing a yellow discolouration to the meat and also affecting its quality.
- The parasitic crab *Pinnotheres* sp. was observed in the mussel samples from Calicut.

FUNDING AGENCY	**ICAR Revolving Fund**
PROJECT TITLE	**Production of agar from the seaweeds of Gulf of mannar and Palk bay**
SCIENTISTS	**N. Kaliaperumal**
CENTRE	Mandapam Camp

- During April to October, 2003, a total of 664 kg of food grade agar were produced from the red seaweed *Gracilaria edulis* in sheet, bit and powder forms. An income of Rs.1,24,329/- was generated by sale of 594 kg agar. An income of Rs. 6,000/- was also generated by

conducting a training programme on "Agar production" to 2 private entrepreneurs.

FUNDING AGENCY	**Department of Ocean Development**
PROJECT TITLE	**Studies on Marine Mammals of Indian EEZ and the contiguous seas**
SCIENTISTS	**M. Rajagopalan,** E. Vivekanandan, P.K. Krishnakumar, P. Jayasankar & K.P. Said Koya
CENTRE	Cochin, Mangalore, Chennai, Minicoy, Mandapam Camp, Visakhapatnam & Minicoy

- During the period 2003-2004, project personnel participated in the Research Cruises (218, 219, 220, 221 & 222) on board FORV *Sagar Sampada*. Collected data on the sightings of *Stenella* sp, *Sousa chinensis, Tursiops* spp, *Globicephala* spp and *Delphinus delphis*. The number of marine mammal sightings on board FORV *Sagar Sampada* varied from 6 to 20 sightings.
- The Project personnel (Dr. P. Jayasankar and Anoop A. Krishnan) participated in Pilot Expedition to Southern Ocean onboard ORV *Sagar Kanya* during Jan.-March 2004. Collected data on the sightings from Lat. 24º59' Long. 52º32; to Lat. 45º00' Long 57º30'. A total of 21 whales and dolphins sighted in the study area and sei whale *Balaenoptera borealis*, minke whale *B. acutorostrata* and blue whale *B. musculus* were confirmed through photo identification.
- The blubber, liver, kidney samples collected from the stranded common dolphin *Delphinus delphis*, Hump backed dolphin *Sousa chinensis* and Finless porpoise *Neophocaena phocaenoides.* DNA analysis using RAPD and Mt DNA techniques was initiated.

Participants of Southern Ocean Cruise on board *ORV Sagar Kanya*

FUNDING AGENCY	**AP Cess Fund**
PROJECT TITLE	**National Risk Assessment Programme for fish and fish products for domestic and international markets.**
SCIENTISTS	**D. Prema** and N.K. Sanil
CENTRE	Cochin
COLLABORATIVE AGENCY	CIFT, Cochin

The samples of *Perna viridis, Villorita cyprinoids* and *Crassostrea madrasensis* and water and sediment were collected on monthly intervals from geographical area covering northern, central and southern Kerala. Meat, water and sediment were analyzed for heavy metals. Meat was processed for pesticides and sent to CIFT, Cochin for further analysis. Live bivalves were examined for parasites.

The salient results of the analysis made so far are as follows:

- Mercury and arsenic in meat, water and sediment from all the locations were below detectable level.
- Chromium did not exceed the permissible level in any of the samples analyzed.
- Lead and cadmium levels in meat of all bivalve species studied exceed the permissible limits given by WHO.
- Zinc content in *Crassostrea madrasensis* from the southern Kerala exceed the permissible limits.

- ❖ Bivalves examined so far from all the locations were free of parasites of sanitary significance.
- ❖ Parasites of phytosanitary significance included different species of ectocommensal ciliates, ectoparasitic ciliate of the genus *Trichodina*, endoparasitic ciliate (*Stegotricha* sp.) parasite/ associate copepods, pea crab (*Pinnotherus* sp.) and a variety of true associates of edible oysters (Polychaete worms, *Polydora* sp., Amphipods, Barnacles, Pistol shrimps and *Modiolus* sp.).

FUNDING AGENCY	**Ministry of Environment and Forests**
PROJECT TITLE	**Studies on the biology, captive spawning and sea ranching of the seahorse, *Hippocampus sp.***
SCIENTISTS	**A.P. Lipton**
CENTRE	Vizhinjam

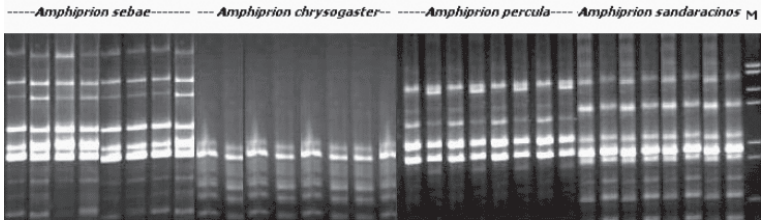
- ◆ Identified species-specific proteins using native PAGE of the different species of seahorses available in Indian coast such as *Hippocampus kuda, H.histrix, H. kellogi, H. zosterae* and *H. trimaculatus*.
- ◆ Information on reproductive behaviour of two species of seahorses in captivity was generated.
- ◆ The captive males and females mate with different partners, although some pairings were repeated. The young ones were released from the pouch in the morning and complete parturition duration extended from 20 to 90 minutes.
- ◆ Laboratory-reared and tagged seahorses were released in Palk Bay coast.

FUNDING AGENCY	**ICAR AP Cess Fund**
PROJECT TITLE	**Development of pro-active disease control strategies for sustainable shrimp farming using marine algal metabolites.**
SCIENTISTS	**A.P. Lipton**
CENTRE	Vizhinjam

- ◆ Advantages of using marine bioactive metabolites isolated from *Ulva*, as a potent therapeutic and growth promoting agent are indicated.
- ◆ The aqueous as well as methanol extracts exhibited antibacterial activity against *Vibrio alginolyticus*.
- ◆ The aqueous as well as methanol extracts showed anticoagulant activity, which was comparable to that of the known anticoagulation agents.
- ◆ In the laboratory trials with *Penaeus monodon* PL20 larvae growth enhancement was noted in the methanolic extract fed group compared to the extract and control groups.
- ◆ In field trials, shrimps attained an average body weight of 35.0g size after 120 days of culture, which showed a difference in growth of about 9.0 g (with average body weight of 26.0 g) compared to the nearby pond in which normal feed was provided to the shrimps. The shrimps fed with one time medicated meal in the experimental pond were healthy, without any infections and mortality while in the other pond, frequent incidences of gill infections, rot in appendages, shell erosions, antenna cut and softening of shrimps were recorded.

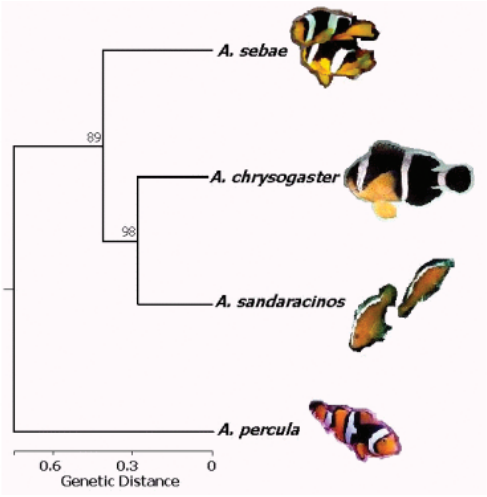
FUNDING AGENCY	**ICAR AP Cess Fund**
PROJECT TITLE	**Evaluation of genetic heterogeneity in marine ornamental fishes using molecular genetic markers**
SCIENTISTS	**P. Jayasankar** and Boby Ignatius
CENTRE	Cochin and Mandapam

- RAPD fingerprints of *Amphiprion sebae, A. chrysogaster, A. percula* and *A. sandaracinos* were developed using primers OPA 08, OPA 10, OPF 02 and OPF 03 with a view to studying their genetic relationships.
- Cluster analysis has shown that *Amphiprion chrysogaster* and *A. sandaracinos* are more closely related. *A. sebae* is relatively closer to this grouping while *A. percula* forms a distinct outgroup.



RAPD profiles of 4 different species of clown fish

- Genetic profiles of over 50 individuals of *Abudefdeuf* spp were generated using arbitrary primers.
- In the search for any possible sex-specific RAPD markers in clown fish, two primers (OPA 05 and OPAA 01) showed some indication of male specific markers.
- Microsatellite primers designed based on published sequences of closely related species *Abudefduf luridus* (F: 5'ATG ACA CGC ATG GCT AAC CT 3' & R: 5' CAT AGA CGC ACA TTG ACT GG 3') have amplified clown fish DNA (Annealing temperature, 52°C) and showed putative sex specific marker.
- With a view to investigating the inheritance pattern of genetic markers from one generation to the other in clown fish, 2 hatchery-bred 'families' consisting of parents and progeny were subjected to RAPD and fragments (including one putative male-specific marker) were found inherited in the progeny from the parents.



Phylogenetic relationship of 4 different species of clown fish

PROJECT CODE	**Agricultural Technology Information Centre**
PROJECT TITLE	**Establishment of Agricultural Technology Information Centre**
SCIENTISTS	**R.Sathiadhas** and Vipinkumar.V.P
CENTRES	Cochin

The Agricultural Technology Information Centre (ATIC) was established to implement a single window delivery system for all the technological inputs, products and services. All the sales/services/products were channeled through Single Window Delivery system under the ATIC of the Institute.

- The ATIC building was commissioned, inaugurated and made operational .

- A publication entitled **'ATIC – Activities and Achievements'** and three **brochures on ATIC in English, Malayalam and Hindi** languages were released.
- The ATIC web site www.aticcmfri.org was launched.
- A total of 2050 farmers/ fishermen/ entrepreneurs visited and interacted with the ATIC during the period under report.
- Sale of products/services had benefited 1542 farmers.
- Diagnostic services and laboratory tests of samples brought by farmers generated an annual revenue of Rs 13,785 /-
- Sale of value added fish products, publications and technological inputs generated an income of Rs 84,293 /-
- Editing works of a series of pamphlets are completed and are in the process of publishing under the operational expenditure.

National Agricultural Technology Projects

The Institute implemented 17 NATP schemes during the year under various research modes such as Production Systems Research (PSR), Competitive Grants Programme (CGP), Mission Mode (MM), Integrated Village Linkage Programme (IVLP) and Agriculture Technology Information Centre (ATIC). The salient findings of the projects are given.

PROJECT CODE **NATP/MM**
PROJECT TITLE **Integrated National Agricultural Resources Information System (INARIS)**
SCIENTISTS **N.G.K. Pillai** and T.V.Sathianandan
CENTRES Cochin (Co-operating Centre)

- The database on 'Technologies' has been modified by incorporating images relevant to the technologies. Data entry has been completed for the 'Project Database' by adding details of all projects taken up at CMFRI and CIFT during the VIIIth and IXth Five-Year Plans.
- Modified the structure of the database on 'Fishery Statistics' by incorporating species groups and species table and relating them in the ER diagram. Also, the species table in the database has been modified by adding details of the groups and species codes.
- Updated the catch table of Fishery Statistics database with production statistics and the export table with information on export of seafood fishes to different countries.

FUNDING AGENCY **NATP (CGP)**
PROJECT TITLE **Broodstock development, breeding, hatchery production and restocking of mud crabs**
SCIENTISTS **E.V.Radhakrishnan** and Mary K. Manisseri
CENTRE Cochin

Two experiments on mass production of the mud crab *Scylla tranquebarica* were carried out. Female crab with spermatophore and gravid ovary brought from the wild spawned viable eggs after 12 days. The fecundity was estimated as 1.64 million. 20% of the eggs were unfertilized. Larvae obtained from hatching were stocked @ 50 zoea/l in 1 tonne FRP tank with *Nannochloropsis* sp. and *Brachionus rotundiformis*. Rotifer density was maintained at 20 nos/ml. *Artemia nauplii* @ 4 nos/ml were fed from Zoea III onwards. Survival from zoea to megalopa was 50%. Megalopa larvae were transferred to an upwelling system so as to reduce interaction and cannibalism. Survival from megalopa to postlarva (crablet) could be substantially increased from 30% to 50%. Transfer of first crablet immediately to nursery tanks with gravel and shell pieces could reduce cannibalism. 25% survival from zoea to crablet was obtained by careful hatchery management.

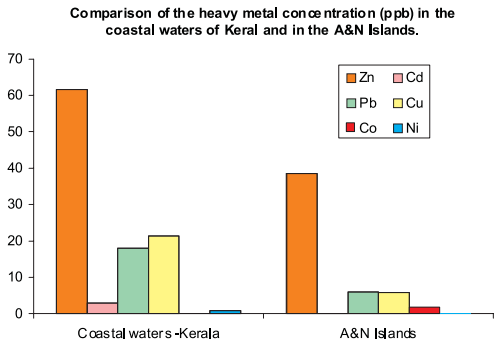
Berried *Scylla serrata*

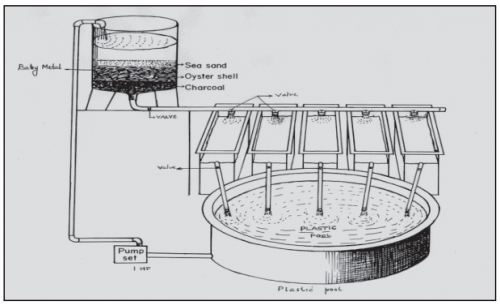
PROJECT CODE **NATP**
PROJECT TITLE **Mussel Mariculture**
SCIENTISTS **T. S. Velayudhan,** V. Kripa, Anil Ranade, R.Soundararajan, K.K.Appukuttan, K. Sunilkumar Mohamed, P. Laxmilatha, N. Ramachandran, Sujitha Thomas, Geetha Sasikumar, P. K. Asokan, R. Sarvesan, P. V. Sreenivasan

In Maharastra (stake, raft and long lines) were launched in Kalbadevi Estuary. Three mini units of stake culture were installed in Purnagad,

Mussel harvested from stake culture farm at Ratnagiri

SHG with seeded mussel rope, Padanna





Prototype for depuration of bivalves

Tulsunde, Bhatya and Mirya villages. For stakes, straight branches of the mangrove trees were selected and used as stakes. In Kerala, new demo farms were set up at Korapuzha estuary (Kozhikode), Dalavapuram (Kollam). In Tamilnadu new farm was set up at Pulicat Lake.

A 'Harvest Mela' was organized at Ratnagiri (Myrya) during 2003 which, some of the products of culture units of the project were harvested and handed over to local fisher women for sale. Subsequently 3 fisher women groups started their own mussel culture there, independently in Bhatya creek. 2 tons of cultured mussels of the fisher women groups were exported to Mauritius.

Mussel Mariculture

Training programs for farmers were organized in the coastal villages, Purnagad, Tulsunde, Bhatya and Myrya. 100 fishermen and women attended the same. 250 fishers involving SHG groups were trained in Kerala and Maharastra. Under the ATMA programme of the Maharashtra State Fisheries Department, 10 mussel farmers were trained in Mussel culture activities at Kozhikode RC of CMFRI.

The mussel farming programmes under NATP has motivated several villagers to take up mussel farming in Kerala and Maharashtra. A fisherman family at the village Juve did mussel culture by stake culture method with the help of Project scientists. In the village Mirya, the mussel culture in the intertidal area was started by local fishermen families or as groups. The raft culture method is also attracting attention of the fishers. In the village Kasarveli, a villager has installed a raft with the project help and has attended various works, such as seeding, cleaning and maintenance of the raft structures.

Dr. Swaminathan Committee constituted by the Maharashtra State Government (Year 2003) has also recommended to the State government to undertake steps for the development of Mussel and Oyster farming in the coastal areas and set a target of development of 5000 ha of bivalve cultivations during the next decade. This can add an annual production of about 1.00 to 1.50 lakh tons of shellfish to the State's fish production and will open a new avenue of low-cost, environment-friendly livelihood opportunity for the coastal rural populations.

The mussel seed resources of Gujarat, Maharashtra, Goa, & Orissa were estimated as 2849t, 0.030t, 44.22t from 7230, 2000 & 61092 m^2 respectively.

Regular monitoring of trace metals, biotoxins and hydrocarbons was done along the mussel farms of Kerala coast. In other maritime states the sampling was restricted to the farming season. Along Kerala coast the trace metal concentrations in three different ecosystems namely Bay, estuary and open sea were monitored regularly. Copper and Zinc content in water were lowest (0.0012 and 0.00278ppm) in the estuary, compared to the open sea and bay while Cadmium, Nickel and Zinc were lowest (0.0006, 0.00063 and 0.0008ppm) in the bay. Silver content was below detectable level both in the open sea water and in the estuary while in the bay it was slightly higher, 0.0012ppm.

Heavy metal concentration was much below the permissible limit. Mercury was completely absent in all the water samples analyzed from

the three regions. In the estuary and sea, concentration of zinc was the highest while in the bay, copper was dominant. The concentrations of all the metals were comparatively higher during the post monsoon period (Oct–Nov) and showed a decreasing trend in the succeeding period in the estuarine and coastal waters. However the trace metal concentration did not show any seasonal fluctuation.

The trace metal concentration in the Andaman and Nicobar seas was much lower than in the sea and coastal region near the main land along the Kerala coast.

A prototype for simple continuous flow through system for depuration was developed. Multi Layer Sand bed Filter was designed for filtration.

PROJECT CODE	**NATP/PSR**
PROJECT TITLE	**Breeding and culture of pearl oysters and production of pearls**
SCIENTISTS	**K.K. Appukuttan,** K.S. Mohamed, T.S. Velayudhan, V. Kripa, D.C.V. Easterson, A.C.C. Victor, S. Dharmaraj, N. Ramachandran and M.K. Anil
CENTRES	Cochin, Tuticorin and Vizhinjam

Make-up Pearl Investigations

Studies were made on uptake by the pearl oysters of allochthonous metals into nacre in higher quantity so as to decisively influence the colour of the nacre. The safe level of chromogenic metals dosage suitable for administration was broadly estimated following LC_{50} methodology. The results obtained for pearl oysters were as follows:

COPPER	0.53 ppm	(Copper sulphate 5 ppm)
COBALT	2.89 ppm	(Cobalt nitrate 9 ppm)
COBALT	2.9 ppm	(Cobalt sulphate 6 ppm)
IRON	3.4 ppm	(Ferric chloride 10 ppm)
MANGANESE	8.4 ppm	(Manganese sulphate 308 ppm)
MOLYBDENUM	3.8 ppm	(Ammonium molybdate 7 ppm)

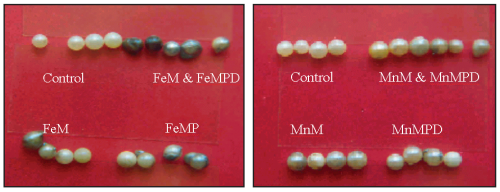
Uptake of Iron

Uptake of iron and checking its ability to reach nacre and change colour was first attempted in the fast growing pearl oysters spats. Microparticulate diet (MPD) having 35% protein and other essential nutrients present in a balanced ratio was prepared, bound with carageenan and particulated to about 5μ in diameter using a pulveriser.

Freshly nucleated adult oysters were reared in the MPD having 10 ppm Ferric chloride (FeMPD), Ferric chloride at 10 ppm level enriched sea water medium (FeM) and other set of experimental tank having both of the above *viz.*, FeMPD & FeM. As control a set oysters were reared with the diet of mass cultured *Isochrysis galbana*.

Estimate of metal uptake

Analysis of iron and manganese in pearl oysters indicated that in respect of iron the accumulation among the tissues of visceral mass, muscle and mantle was lowest in visceral mass and highest in the mantle. The iron accumulation results indicate that absorption of iron was higher in those reared in FeM & FeMPD. Absorption of iron through body surface was greater than that of absorption from food *i.e.*, by the gastro-enteric system.



Colour modification in cultured pearls exposed to heavy metals

Tissue	*I.galbana* (Control)	FeM	FeMPD	FeM & FeMPD
Mantle	2.42	7.47	6.95	18.93
Muscle	1.88	6.24	3.46	4.48
Visceral mass	0.79	3.45	2.13	3.46

The results obtained in oysters with manganese also showed similar picture to that of iron, but the level of accumulation was very high compared with that of manganese content in the natural oysters.

Tissue	*Isochrysis galbana* (control)	MnM	MnMPD	MnM& MnMPD
Mantle	2.14	75.91	66.36	89.54
Muscle	3.27	51.15	28.07	95.0
Visceralmass	2.44	16.62	20.44	333.75

Colour modification – the beginning of Make-up Pearls

Among iron and manganese the colour modification was significant in the case of iron as could be seen in the enclosed photograph. Among the experimental groups colour modification was intense in these oysters reared in FeMPD & FeM followed by FeM and those lastly FeMPD. The modified colour was medium violet to mercury.

Identification was observed, though of less intense nature, it was light orange to greyish orange. The results show that colour modification is possible with metal enrichment. Metal enrichment did not affect lustre of the pearl.

In-Vitro Pearl Production

In a major global breakthrough, the technology to produce tissue cultured marine pearls from the Indian Pearl oyster *P. fucata* and the abalone *Haliotis varia* was developed. In an organ culture, the mantle tissues and a sterile shell bead nucleus were placed in a culture flask containing a nutrient rich medium (Modified medium 199). This shell bead got coated with a distinct nacreous layer with organic matrix and a pearl sac was formed within 3 months. The mantle draft produced calcite and rhombhederal crystals. Polygonal prismatic layer was formed with thick inter-lamellar matrix at its boundary.

The present research is highly significant in view of the fact that culturing the mantle tissue in nutrient rich medium and achieving crystallization of nacre has not been reported hitherto from any part of the world. A patent has been applied for this in-vitro pearl production technology.

Mabe Pearl Production Technology

The technology for Mabe pearl production was further refined by standardizing the technique for production of base images with 10 different types of moulds and using a shell powder and Araldite blend. Creation of pendant jewellary with the image was also attempted. Some of the images produced are shown below.

Cultured Mabe Pearls

On-Farm Spat Collection

Spat fall season was observed from Nov to Mar. The shade net hapa treatment resulted in more than 35% of the spat collected from Raft-1. The other holding cages suspended from the raft also resulted in spat fall. This indicates that captive broodstock oysters are necessary in the spat collector for successful collection of spats. External spat collectors were not successful, even though pearl oyster stock was present on the raft. The peak period of spat fall during 2001-02 was December to February. There was no spat fall during 2002-03 seasons. However, during 2003-04 seasons, spat fall has been observed to be very intense and more than 4000 spat were collected from a single raft.

- Studies were made on uptake by the pearl oysters of allochthonous metals into nacre in higher quantity so as to decisively influence the colour of the nacre. The safe level of chromogenic metals dosage suitable for administration was broadly estimated following LC_{50} methodology. Oysters exposed to 10 ppm $FeCl_3$, took 48 h to reach hepatopancreas and foot and 72 h to reach the mantle and muscle.
- Among iron and manganese the colour modification was significant in the case of iron. Among the experimental groups colour modification was intense in those oysters reared in iron as a micro-particulate diet and ferric in the seawater medium. The modified colour was medium violet to mercury.
- In case of manganese too colour modification was observed, though of less intense nature, it was light orange to grayish orange. The results show that colour modification is possible with metal enrichment. Metal enrichment did not affect lustre of the pearl.
- In a major global breakthrough, the technology to produce tissue cultured marine pearls from the Indian Pearl oyster *P. fucata* and the abalone *Haliotis varia* was developed.
- In an organ culture, the mantle tissues and a sterile shell bead nucleus were placed in a culture flask containing a nutrient rich medium (Modified medium 199). This shell bead got coated with a distinct nacreous layer with organic matrix and a pearl sac was formed within 3 months. The mantle draft produced calcite and rhombhederal crystals. Polygonal prismatic layer was formed with thick inter-lamellar matrix at its boundary.
- The present research is highly significant in view of the fact that culturing the mantle tissue in nutrient rich medium and achieving crystallization of nacre has not been reported hitherto from any part of the world.
- The technology for Mabe pearl production was further refined by standardizing the technique for production of base images with 10 different types of moulds and using a shell powder and Araldite blend. Creation of pendant jewellery with the image was also attempted.
- More than 4000 pearl oyster spat were collected from Thangassery Pearl farm during December to January using special spat collectors.

PROJECT CODE	**NATP**
PROJECT TITLE	**Natural Resources Management - Coral Reef Ecosystem**
SCIENTISTS	**A.C.C. Victor**
CENTRES	Mandapam

- Shore line morphology of the islands was delineated using different satellite imageries. The shore line alignment has been observed to have changed due to illicit coral mining. Illicit mining has built the long shore bar towards North West.
- This study provides, for the first time, a comparison of multidata sensors for coral reef habitat mapping in Gulf of Mannar. The mixed algae – coral – sand spectra in different proportions and at different spatial resolutions have provided the relative importance of classification on coral reef habitat.
- From the intensive study, it is concluded that the proportions of the different classes within the studied reef are very important. According to image interpretation, Van Island underwent a loss in live and dead coral more than 90% whereas Koswar Island has a loss of 50% live coral cover.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Impact of dams on river run-off into sea and changes in the nutrient and productivity profile of coastal waters**
SCIENTISTS	**P.K. Krishnakumar,** P. Kaladharan, D. Prema, K. Vijayakumaran and Shobha Kizhakudan.
CENTRE	Veraval, Mangalore, Cochin, Visakhapatnam

- ❖ Reduction of river discharge due to river impoundment and dams has resulted in major environmental changes in the estuarine coastal sea ecosystem. The river discharge rate was found to be influencing the nutrient biogeochemistry, productivity and sediment flux in the estuarine and coastal waters on which several biota are dependent.
- ❖ Water salinity and pH showed significant negative correlations with river discharge and high saline conditions were observed in the estuaries and river mouths from areas with low river discharge (eg. Periyar River). Low dissolved oxygen content in estuarine and coastal waters was significantly coincided with reduced river discharge (Bhadar River in Gujarat and Gosthani River in AP). The silicate content in the coastal waters was found to be positively correlated with river discharge rate.
- ❖ Primary productivity and chlorophyll content in the estuaries and coastal waters of the study area were found to be decreasing with reduction in river discharge rates. Levels of BOD, ammonia and toxic trace metals (Cd, Pb, Cu and Zn) in the estuarine and coastal waters were found to be high in areas with low river discharge.
- ❖ Sediment bound sand, total silica and nutrients were found to be positively related to river discharge while, silt, clay and toxic metals were found to be negatively correlated with discharge.
- ❖ Reduced river discharge from Gujarat coast has converted some of the river mouths into high saline creeks and affected the estuarine and mangrove habitats. Analysis of historic data on river discharge

showed that the fresh water discharge into the coastal waters was reducing at an alarming rate due to damming or river diversions.

- River runoffs provide energy for a number of vital processes in downstream estuaries, delta and coastal areas, which includes transport of nutrients, organic matter and nutrient rich silt, oxygen enrichment, entrainment of nutrients in bottom sediments, dilution and flushing of pollutants etc. The findings of the present study are important to the proposed River linking project.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Mangrove ecosystem: Biodiversity and its influence on the natural recruitment of selected commercially important finfish and shell fish species in fisheries**
SCIENTISTS	**George. J.P.,** G.S.D. Selvaraj, P.Kaladharan, T.S. Naomi and D. Prema
CENTRE	Cochin

The two-year investigations on the aqua-edaphic parameters and biodiversity of selected Mangroves of Kerala, West Bengal & Andaman Nicobar Islands revealed that:-

- Conservative and non-conservative parameters although exhibited tremendous seasonal variations according to location, prevailed agro-climatic conditions and local anthropogenic activities, the ecosystems were conducive for a moderate proliferation, growth and survival of flora and fauna. Nevertheless, some of the economically important species are rarely occurred or almost nearing disappearance.
- The macroflora of the mangroves belongs to littoral swamp forest under helophilous halophytes implies that the mangrove forest investigated are in general a heterogenous type with following groups:-

(a) True mangroves (b) Mangroves associates (c) Back mangroves/ Mangrove bioinvasive (d) Coastal/Beach flora (e) parasites/Epiphytes/ mistletoes. The very common species combination observed in the three mangroves consisted of *Acanthus ilicifolius*, *Rhizophora apiculata*, *R. mucronata*, *Bruguiera gymnorrhiza*, *Avicennia marina*, *A.officinalis*, *Ceriops tagal*, *Excoecaria agallocha* and *Sonneratia alba*.

- Microflora: Although species of Myxophyceae and Chlorophyceae and Euglinophyceae exhibited their presence, centric box type diatoms belonged to Bacillariophyceae dominated in the phytoplankton.
- The fauna is represented by:- a) Arboreal species (b) Avian species (c) Amphibia (d) Reptiles (e) Mammals (f) Aquatic species. Among the microfauna, copepods and larvae of ichthyofauna were predominant among the zooplankton. The Benthic community comprised mainly polychaetes and shellfish and crustacea. The species composition was greatly different in the three mangroves due different agro climatic conditions topography and tidal amplitude.
- All the mangroves are greatly associated with estuaries and creeks except the Andamans where most of them are fringing mangroves. Due to heavy surface run-off the salinity variations takes place and mangrove forest developed in the lower fringe areas of hills. Above the high tide level true terrestrial forest formed and hence dependence

on mangroves by local population is less since true forest products are available in A&N islands.

- ❖ All the mangroves have rich potential to substantially contribute towards the capture fishery resources of Arabian Sea and Bay of Bengal. However the over exploitation of ichthyofauna especially the fish and prawn seed collection have resulted in the dwindling of natural recruitment and thereby the coastal capture fisheries especially artisanal fishery has been considerably adversely affected.
- ❖ Approximately 3-5 crore seeds of *Penaeus indicus* & *Metapenaeus dobsoni* are collected annually from Kerala mangroves for aquaculture. About 23 seeds of other species were destroyed to collect one *Penaeus monodon* postlarvae from Sunderbans in West Bengal resulted in the dwindling of prawn fishery in the North East coast of India.
- ❖ The population of common brackishwater fishes such *Etroplus suratensis*, *Mugil cephalus*, *Lisa parsia*, *Chanos chanos* and Crustaceans such as *Macrobrachium rosenbergii*, *Scylla serrata* have decreased drastically and that has very adversely affected the economic condition of artisanal fishermen in Kerala.
- ❖ The transformation of general topography of mangroves by reclamation for agriculture purposes seriously affected the tidal inundation and destroyed the breeding, feeding areas and migratory path of fishes. The *Hilsa* and *Anguilla* population of Bengal have decreased, since the species cannot migrate upstream and down stream through mangroves for breeding purposes.
- ❖ Over exploitation of mangrove forest and other related resources destroyed the possibilities of certain mangroves in the country to regenerate and rejuvenate.
- ❖ All the mangroves studied are dumping places directly or indirectly or act as sink for pollutants.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Nutrition and Pathology in Mariculture**
SCIENTISTS	**R. Paul Raj,** D.C.V. Easterson, K. C. George, A.P. Lipton, Imelda Joseph
CENTRE	Cochin

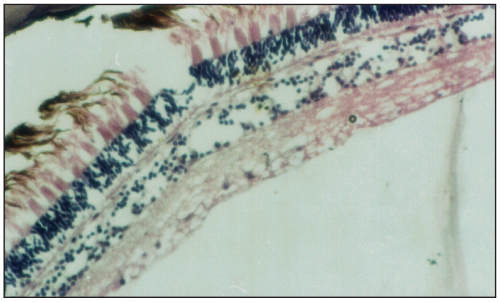
The project was completed during the year and completion report submitted.

- ◆ The optimum feed ration for the juvenile mud crabs was found to be 7.5 % of body weight for wet natural feeds such as fish and clam, 5% for salted fish and 2.5% for dry clam meat.
- ◆ A pellet feed (3 to 5mm) containing 40% protein has been successfully developed for raising juvenile mud crabs (*Scylla serrata*), with locally available ingredients a specially formulated mineral mix, and guar gum as binder. This first time achievement opens up opportunities for mud crab farming with off-the shelf eco-friendly feeds.
- ◆ Weaning trials of formulated pellet feeds showed that juvenile crabs of size less than 100g can be weaned in a day; crabs of size 100 to

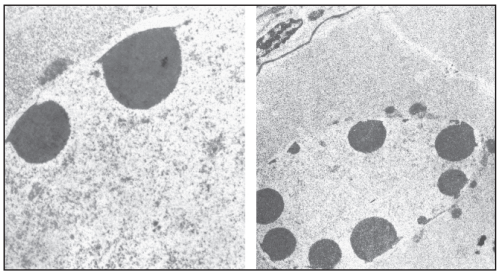
500 g take 2-3 days and those above 500g take 3-4 days for weaning to the pellet diet. Under laboratory conditions, once weaned, the duration of inciting a feeding response substantially gets improved as the crabs consumed the feed offered in 30 to 90 minutes.

- A crude protein level between 40 and 45 % in the formulated feed was found to give best response in terms FCR, PER and SGR for the juvenile mud crabs.
- The feeding rate for formulated pellet feed was optimized at 4% of body weight for the juveniles of 0.25 g to 15 g, 3 % for crabs of 15 to 200g and 2.5 % for those above 200 g.
- A product obtained by solid-state fermentation of soybean flour for 48 hrs using *Bacillus coagulans* was successfully used as a partial substitute (up to 60%) for fishmeal in the diets of juvenile *Penaeus monodon*. Another product derived by solid state fermentation of a mixture of soybean flour, wheat flour, groundnut oil cake and gingelly oil cake in the ratio 4:3:2:1 using the bacteria *Bacillus coagulans* for 36 hrs and fungi *Aspergillus niger* strain 616 for 96 hrs showed that fishmeal can be replaced in the diet of post larval *P. monodon* upto 100% with bacterial and 43% with fungal fermented products with 100% survival and better growth performance.
- Around 50-60% infections in lobster (*P.homarus)* reared in holding facilities for live export were of bacterial aetiology predominated by vibrios. Tail rot caused by *V.parahaemolyticus* was the most common disease recorded. Frequencies of infection were more with the increase of animal size. In addition to *V. parahaemolyticus, V. cholerae*, and *V. harveyi* were also isolated. Infection of *V. parahaemolyticus (*10^7 cells/ml) isolated from the tail rot portion of *P. homarus showed* an initial decrease in total haemocyte counts and the haemocyte number recovered in 24 h.
- Genetic characterization of *V. cholerae* and *V. parahaemolyticus* isolated from diseased lobsters and other marine sources, showed that both species from the above sources did not possess human pathogenic genes.
- 85% of the vibrios isolated from lobster hatchery belonged to *V. harveyi. V. harveyi* load in Artemia rearing water was very high and suggested as the source of Vibrio infection in phyllosoma larvae.
- Infection by vibrios was identified as the major cause for larval mortality in pearl oyster larval rearing systems. Micro algal feed supplied to the larvae had high microbial load, which may serve as the source of pathogenic microbes.
- An experimental trial to evaluate the efficacy of *Lactobacillus* as a probiotic in pearl oyster hatchery showed that *Lactobacillus* significantly improves survival of larvae as well as eventual settlement as spat
- When AFB_1 incorporated diets (at 50, 100, 150ppb, 1ppm and 2ppm) were fed for 60 days to juvenile *P. monodon* high levels of aflatoxin in the diet significantly altered immune parameters such as total haemocyte count and phenoloxidase activity.

FUNDING AGENCY	**NATP (CGP)**
PROJECT TITLE	**Development of a National Referral laboratory for Marine fish and shell fish Microbial diseases**
SCIENTISTS	**K.C. George,** P. C. Thomas, N.K. Sanil and K.S. Sobhana
CENTRE	Cochin



Grouper viral encephalopathy and retinopathy



M B V occulusion bodies and viral particles

- About twenty cases of disease outbreaks were recorded. Samples were collected for histopathological, microbiological, ultrastructural and molecular level investigations from healthy and infected specimens.
- One hundred and twenty five (125) isolates of *Vibrio a*nd fifty seven (57) isolates of *Aeromonas* and eight (8) isolates of *Pseudomonas* have been obtained from infected organisms.
- Out of the hundred and twenty-five isolates of *Vibrio*, thirty-six (36) have been characterised. They are *Vibrio parahaemolyticus* (12), *V. alginolyticus* (2), *V. anguillarum* (12), *V. vulnificus* (6), *V. cambelli* (2) and *V. damsella* (2). Seven *Aeromonas* species are also identified as *Aeromonas hydrophila* (5) and *A. sorbia (2).*
- Septicemic *Etroplus suratensis* was subjected to histopatholgical analysis (plate 1& II). Liver, kidney, spleen, muscle, gills and heart were examined for pathological changes.
- In another case of mortality from an *Etroplus suratensis* farm due to ulcerative disease, *Aeromonas* dominated bacterial isolates obtained from the blood of the fish. A fungus was also isolated from the muscle near the ulcerative area.
- Polyclonal antibodies have been raised against different bacterial pathogens and agglutination and immunodiffusion tests for the identification of bacteria have been developed.

FUNDING AGENCY	**NATP**
PROJECT TITLE	**Shrimp and fish brood stock development and breeding under captive condition**
SCIENTISTS	**Shri. D. Kandasami**

Brood stock management and spawning of *Epinephelus merra*

- The broodstock was fed with different kinds of feed enriched with polyunsaturated fatty acids (PUFA) and after a period of 10-12 months 19 spawning were recorded. The fecundity ranged from 13,700 to 3,09,300 eggs in different spawning.
- Induced maturation of the brood fish of *E. merra* was also attempted by administering Ova prim at the rate of 0.5ml / kg body weight and successful results were obtained two cases.

PROJECT CODE	**NATP**
PROJECT TITLE	**Institution-Village-Linkage-Programme for technology assessment and refinement in the coastal agro ecosystem of Ernakulam in Kerala**
SCIENTISTS	**R.Sathiadhas,** Sheela Immanuel, L.Krishnan, A.Laxminarayana and D.Noble
CENTRES	Cochin

Various Interventions under the project were continued at Elamkunnapuzha Village of Vypeen Island in Ernakulam District of Kerala. In the second phase 13 types of interventions were implemented in fisheries (4), Livestock (3) and agriculture (6).

- Nine training programmes were conducted during the period in which a total number of 440 farmers participated comprising of 228 women and 212 men. The themes of training programmes were biculture practices (crab with *M. cephalus* and *P.indicus* with finfish), scientific crab fattening, monoculture of *Mugil cephalus*, scientific rabbit farming duck farming, vegetable cultivation on embankments of paddy fields, intercropping of amaranthus with banana and rice cultivation using bio-fertilisers

Interventions [Usable Technologies]

Sl. No	Interventions	Net Returns (Rs.)	B-C Ratio
1	Monoculture of *Mugil cephalus*	2,75,750/ha	1.37:1
2	Monoculture of Milk fish	2,23,200/ha	1.24:1
3	Rearing of improved breed of broiler rabbits (*Grey Giant*) in homesteads	4,240/year	1.46:1
4	Rearing of *Kuttanadan* ducks	4,320/year	1.33:1
5	Cultivation of Para grass on Unutilized marshy lands	35,000/ha	1.16:1
6	Farming of improved variety of Ridgegourd (*Indam 1222*)	83,385/ha	3.94:1
7	Farming of improved variety of Salad cucumber (*Poincetae*)	62,725/ha	3.32:1
8	Farming of improved variety of Vegetable Cowpea (*Arka garima*)	41,380/ha	2.16:1
9	Rice cultivation using bio fertilizers (Azolla)	8,800/ha	0.22:1

Harvesting of *Chanos chanos*

Stocking of *Mugil cephalus*

PROJECT CODE NATP

PROJECT TITLE **Designing and Validation of Communication Strategies for Responsible/Sustainable Fisheries A Co –Learning Approach**

SCIENTISTS **C.Ramchandran,** S.Ashaletha, V.P.Vipin kumar and R.Narayana Kumar

CENTRES Cochin

- Launched a **state wide campaign on responsible fisheries** and a two- day Co learning workshop on responsible fisheries was conducted in collaboration with MCITRA, an NGO, at Kozhikode. The campaign has been conceived as a series of co learning workshops to make the fisherfolk aware about responsible fisheries management approach. The first workshop in the series was conducted for 48 persons representing different stakeholders from the fisheries sector at Kozhikode during 12-14 August. The workshop in which scientists from CMFRI and CIFT acted as facilitators
- A Responsible Fisheries Extension Module (RFEM), first of its kind in the country, consisting of various communication tools like Malayalam translation of FAO Code of conduct for responsible fisheries, (which was brought out in agreement with FAO, Rome),an illustrated fisher friendly version of the FAO code of conduct , an animation film *Kunjumeenum kothukuvalayum* ("Tiny fish and mosquito net") leaflets and pamphlets etc has been validated with respect to different stakeholder constituencies.

Two days Co-learning workshop conducted at Kozhikode to mark the launching of the state wide campaign on responsible fisheries

- A total of 1041 copies of the publications were disseminated to different stakeholders like officers in the State Dept.of Fisheries, NGOs , fishers, Coastal Panchayats, etc. The module has been made available electronically at www.aticcmfri.org under the link titled Responsible Fisheries Extension-CMFRI Initiatives in India.
- The Assessment of Responsible Fisheries Information Needs (ARFIN) indicated a preference for tools belonging to the category of Contrived Experiences in the Dale's typology by more than 88% of the respondents.
- The feedback analysis on the effectiveness of the animation film done after its telecast through Doordarshan (with an estimated viewership of 15 lakh) during June-August 2003 indicated that it was rated by 92% of the respondents as a very effective conscientisation tool for responsible fisheries. The film was short-listed in the prestigious Global Environmental Film Festival 2003("Earth Vision" http//www.earth-vision.jp)) held at Tokyo, Japan.
- The cases of stakeholder –induced fisheries management regimes (for eg. the "***Kadakkodathies*** (sea courts) of Malabar coast and activities of NGOs like Green seas) have been video –documented and critically analysed in juxtaposition with State –induced management/regulatory regimes.

PROJECT CODE **NATP**

PROJECT TITLE **Studies on Fisherwomen in Coastal Eco-System of Andhra Pradesh, Karnataka, Tamil Nadu and Kerala**

SCIENTISTS **R. Sathiadhas,** H.Mohammed Kasim and R. Narayanakumar

CENTRES Cochin, Chennai and Kakinada

Medical camp at Poovar

Project Team interacting with women stakeholders

On the basis of preliminary investigation, 9 villages from Andhra Pradesh, 5 from Kerala and 6 from Tamil Nadu were selected for detailed study. The socioeconomic parameters like ownership of means of production, occupational pattern, income, expenditure and problems hampering women development and their empowerment have been analysed .

The average annual income of a fisherwoman in Kerala varied according to their occupations, Rs. 8232 in sorting, Rs. 9720 in peeling, Rs. 18000 in value additions, Rs. 23328 in curing and Rs. 59760 in vending.

- The consumption of cereals was high in Andhra Pradesh as it was a staple food . The consumption of pulses, vegetables, oils, milk and milk products was found to be high among the women of Kerala followed by Andhra Pradesh. Consumption of macronutrients, vitamins and minerals was high in Kerala, followed by Tamil Nadu and Andhra Pradesh. Though the nutritional status was found to be relatively normal in Kerala, the deficiency of Vitamin C, Vitamin B2 and iron was observed.
- 69.2% of fisher women examined were anaemic. Other clinical symptoms observed were angular stomatitis, chelosis, bleeding gums, dryness of skin, headache, backache, body pain, chest pain, myalgia, bone tenderness, numbness of extremities, breathing problem and joint pain.
- When fisherwomen and children were taken together the average BMI was calculated to be 20. A number of training programmes and medical camps were also conducted in the selected areas.

Technology Assessed & Transferred

Lobster farming

The package of technologies developed by the Institute for Intensive farming of lobsters in indoor system was transferred to the Rajiv Gandhi Centre for Aquaculture, Sirkazhi, Tamilnadu under the Consultancy programme of the Institute. The technology will be demonstrated in the TNFDC shrimp hatchery at Neelangarai, Chennai, which was leased out to RGCA. The tanks have been modified to suit lobster farming. Undersized lobsters incidentally entangled in lobster fishing nets will be used for farming so that value addition to these low-priced lobsters could be achieved.

Releasing undersized lobsters in indoor growout system

Semi automated mussel seeding machine

The Molluscan Fisheries Division of CMFRI has designed a semi automated seeding machine. This has been tested in the field through demonstratin with the help of mussel farmers and upgraded. The modified machine is being used by the mussel farmers of Malabar region and has been widely accepted by the farmers.

Demonstration of mussel seeding machine to mussel farmers

Duplex PCR kit

Rights for production and marketing of the CMFRI Duplex PCR kit on commercial basis was awarded to M/s Microl Remedies, Hyderabad. This kit is cost effective and rapid compared to the nested PCR. Simultaneous PCR screening of different segments of the viral genome is carried out in a single step using the Duplex kit. This saves time and cost compared to the nested kit.

Prof. (Dr.) M.J. Modayil, Director handing over the CMFRI Duplex PCR Kit to Shri. Harikrishnan, General Manager, Microl Remedies, Hyderabad

EDUCATION & TRAINING

Post Graduate Programme In Mariculture

Ph.D. Programme

- A total of 14 regular students and Senior Research Fellows in sponsored projects of the Institute were awarded Ph. D Degrees during the period as detailed below:

Central Institute of Fisheries Education (Deemed University)

- Ms. Suja. N, for her thesis entitled "Studies on the reproduction of *Marcia opima* (Gmelin)" under the guidance of Dr. P. Muthiah, Principal Scientist, Tuticorin Research Centre of CMFRI.
- Mr. Sreeraj. G, for his thesis entitled "Studies on the reproductive biology, breeding and larval rearing of selected marine ornamental fishes belonging to the family *Pomacentridae*" under the guidance of Dr. G. Gopakumar, Principal Scientist, Vizhinjam Research Centre of CMFRI.
- Ms. Rachel Fernandez for her thesis entitled "Neuroendocrine control of vitellogenesis in the spiny lobster *Panulirus homarus* (Linnaeus, 1758)" under the guidance of Dr. E.V. Radhakrishnan, Principal Scientist & Head, Crustacean Fisheries Division.
- Ms. I. Sandhya Rani for her thesis entitled "Ecophysiology of pathogenic Vibrionaceae from cultured O*reochromis mossambicus*" under the guidance of Dr. (Mrs.) V. Chandrika, Principal Scientist.
- Ms. Mary Asha Antony, for her thesis entitled "Carotenoid profiles in relation to maturation, moulting, food and habitat in the Indian spiny lobster *Panulirus homarus* (Linnaeus, 1758)" under the guidance of Dr. M. Vijayakumaran, Principal Scientist (Retd.) and Dr. R. Paul Raj, Head, PNPD.
- Ms. Bindhu Varghese, for her thesis entitled "Some immunobiological aspects of the spiny lobster *Panulirus homarus* (Linnaeus, 1758)" under the guidance of Dr. E.V. Radhakrishnan, Head, CFD.
- Mr. Puthra Pravin ,for his thesis entitled "Studies on shrimp harvesting techniques in aquaculture" under the guidance of Dr. K. Ravindran, Former Director , CIFT, Cochin

Manonmaniam Sundaranar University

- Smt. Girijakumariamma, Lecturer, Sr. Scale, FIP for her thesis entitled "Influence of detritus on the physiology and growth of *Penaeus monodon* and *Etroplus maculatus*" under the guidance of Dr. A.P. Lipton, Principal Scientist.
- Mr. Thampi Raj (Research student) for his thesis entitled "Studies in microbial diseases of sea horse reared in captivity and their management" under the guidance of Dr. A.P. Lipton, Principal Scientist.
- Mr. Aldous J. Huxely (SRF, ICAR Ad-hoc project) for his thesis entitled " Studies on the non-specific immunomodulation in *P. monodon* with special reference to protection against common bacterial pathogens" under the guidance of Dr. A.P. Lipton, Principal Scientist.

University of Madras

- Mr. Soumya Haldar (SRF, NATP Project) for his thesis entitled "Studies on some aspects of *Vibrio parahaemolyticus* and *Vibrio*

cholerae isolated from the shrimp culture systems" under the guidance of Dr. M. Vijayakumaran, Principal Scientist (Retd.).

- Mr. Sandip Kumar Mandal, (SRF) for his thesis entitled "Physiological studies on the marine pearl oyster *Pinctada fucata* (Gould) (Pteridae:Bivalvia)" under the guidance of Dr. P.V. Sreenivasan, Principal Scientist , Madras Research Centre of CMFRI.
- Mr.S. Venkatesan, SRF, for his thesis entitled "Ecological and physiological studies on the green sea turtle *Chelonia mydas*" under the guidance of Dr. M. Rajagopalan, Principal Scientist & Head, FEMD.

Cochin University of Science & Technology

- Mr. Vincent Terrence Rebello, for his thesis entitled "Genetic studies of the marine penaeid prawn *Penaeus monodon* Fabricius, 1978" under the guidance of Dr. M.K. George, Principal Scientist Retd.
- Five Ph.D students of Mariculture Programme of CIFE, two students of Marine Sciences of the Cochin University of Science and Technology, and one student of University of Kerala have submitted their thesis for adjudication and the results are awaited.
- Eight students of the Ph.D. (MC) are progressing with their thesis work

M.F.Sc. Programme

- Ten students of 2001-2003 (20th batch) have completed their final semester in August, 2003 and left the Institute.
- Five students of 2002-2004 (21st batch) have joined the programme at this Institute for the 2nd semester course programme after undergoing their first Semester at CIFE (DU), in March 2003.

FOCARS 76 FET Training (NAARM)

- As part of the 76th FOCARS Training of National Academy of Agricultural Research Management (NAARM) Hyderabad, the following ARS Scientists Probationers underwent their Field Experience Training (FET) at this Institute from 28th June to 12th July 2003.

  1. V.R. Madhu
  2. Sandhya Sukumaran
  3. K. Rekha Devi
  4. L. Narasimha Murthy
  5. Dr. Kajal Chakraborty
  6. Khushyal Singh

- **Institutional Training** was offered to the following scientists for a period of six weeks.

  1. V.R. Madhu
  2. Sandhya Sukumaran
  3. K. Rekha Devi
  4. V. Venkatesan
  5. Dr. Kajal Chakraborty
  6. Paramita Banerjee

New Facilities created in PGPM.

- A computer facility for the exclusive use of PGPM students has been created.

POST GRADUATE PROGRAMME IN MARICULTURE

Ph.D. Programme

Sl No.	Title	University	Student	Major Advisor
1	"Studies on the reproduction of *Marcia opima* (Gmelin)"	CIFE	Ms. Suja. N	Dr. P. Muthiah, Principal Scientist
2	"Studies on the reproductive biology, breeding and larval rearing of selected marine ornamental fishes belonging to the family *Pomacentridae*"	CIFE	Mr. Sreeraj. G	Dr. G. Gopakumar, Principal Scientist, CFD
3	"Neuroendocrine control of vitellogenesis in the spiny lobster *Panulirus homarus* (Linnaeus, 1758)"	CIFE	Ms. Rachel Fernandez	Dr. E.V. Radhakrishnan, Head, C Fisheries Division
4	"Ecophysiology of pathogenic Vibrionaceae from cultured O*reochromis mossambicus*"	CIFE	Ms. I. Sandhya Rani	Dr. (Mrs.) V. Chandrika, Principal Scientist
5	"Carotenoid profiles in relation to maturation, moulting, food and habitat in the Indian spiny lobster *Panulirus homarus* (Linnaeus, 1758)"	CIFE	Ms. Mary Asha Antony	Dr. M. Vijayakumaran, Principal Scientist (Retd.) and Dr. R. Paul Raj, Head, PNPD
6	"Some immunobiological aspects of the spiny lobster *Panulirus homarus* (Linnaeus, 1758)"	CIFE	Ms. Bindhu Verghese	Dr. E.V. Radhakrishnan, Head, CFD
7	"Studies on shrimp harvesting techniques in aquaculture"	CIFE	Mr. Puthra Pravin	Dr. K. Ravindran, Former Director, CIFT
8	"Influence of detritus on the physiology and growth of *Penaeus monodon* and *Etroplus maculatus*"	Manonmaniam Sundaranar University	Smt. Girijakumariamma, Lecturer	Dr. A.P. Lipton, Principal Scientist
9	"Studies in microbial diseases of sea horse reared in captivity and their management"	Manonmaniam Sundaranar University	Mr. Thampi Raj	Dr. A.P. Lipton, Principal Scientist
10	"Studies on the non-specific immunomodulation in *P. monodon* with special reference to protection against common bacterial pathogens"	Manonmaniam Sundaranar University	Mr. Aldous J. Huxely	Dr. A.P. Lipton, Principal Scientist
11	"Studies on some aspects of *Vibrio parahaemolyticus* and *Vibrio cholerae* isolated from the shrimp culture systems"	University of Madras	Mr. Soumya Haldar	Dr. M. Vijayakumaran, Principal Scientist (Retd.)
12	"Physiological studies on the marine pearl oyster *Pinctada fucata* (Gould) (Pteridae:Bivalvia)"	University of Madras	Mr. Sandip Kumar Mandal	Dr. P.V. Sreenivasan, Principal Scientist
13	"Ecological and physiological studies on the green sea turtle *Chelonia mydas*"	University of Madras	Mr.S. Venkatesan,	Dr. M. Rajagopalan, Head, FEMD
14	"Genetic studies of the marine penaeid prawn *Penaeus monodon* Fabricius, 1978"	Cochin University of Science & Technology	Mr. Vincent Terrence Rebello	Dr. M.K. George, Principal Scientist (Retd.)

Krishi Vigyan Kendra

Krishi Vigyan Kendras have become the biggest movements in the transfer of Agricultural technologies. The basic philosophy behind KVK is to take care of the local problems of the farmers and to make aware about the latest technological advancements to the farmers of the district by conducting training programmes for practicing farmers, rural youth, rural women and extension workers belonging to the development departments, field level demonstrations, on farms testing, campaigns, farmers meet and mahila meet.

1. Training programmes conducted:

a. Practicing farmers (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Crab farming and fattening	1	45	3	48	10
Agriculture	Jasmine cultivation	2	10	30	40	1
	Coconut cultivation	3	13	44	57	18
Home Science	Shrimp wafer preparation	1	-	11	11	-
Animal husbandry	Poultry farming	1	-	12	12	1
TOTAL (a)		8	68	100	168	30

b. Practicing farmers (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Shrimp farming	4	91	9	100	21
	Fresh water ornamental	1	5	8	13	1
	fish cultureBrackish	2	37	3	40	4
	water fish farming Crab	2	24	16	40	5
	farming and fattening	2	38	2	40	11
	Water quality management in shrimp farm					
Agriculture	Vegetable cultivation	1	11	9	20	1
	Kitchen gardening	1	11	4	15	-
	Jasmine cultivation	2	8	32	40	10
Home Science	Preparation of Shrimp pickle	1	-	20	20	5
TOTAL(b)		16	225	103	328	58

c. Rural Youth (On campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Improved traditional shrimp farming	1	4	16	20	7
Agriculture	Vanilla cultivation	1	13	7	20	3
Home Science	Preparation of Cleaning powder	1	-	20	20	-
	Preparation of Mango jam	1	-	14	14	4
	Preparation of Fish pickle	1	-	20	20	6
	Preparation of Fish wafer	1	-	10	10	2
	Preparation of Fish wafer	1	-			
TOTAL (c)		7	17	97	114	22

d. Rural Youth (Off campus)

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Shrimp farming	2	-	40	40	5
	Fresh water ornamental fish culture	7	78	74	152	21
	Crab farming and fattening	2	11	29	40	10
	Fresh water fish farming	1	16	4	20	-
	Disease management in fresh water ornamental fish culture	1	8	2	10	2
Agriculture	Mushroom cultivation	5	4	86	90	19
	Jasmine cultivation	11	21	198	219	20
	Kitchen gardening	1	13	7	20	-
	Integrated pest management in vegetables Vermi compost making	1	4	17	20	1
Home Science	Preparation of Shrimp pickle					
	Preparation of Mango squash					
	Preparation of Mango pickle					
	Preparation of Orange squash					
	Preparation of Pine apple jam					
	Preparation of Pine apple squash					
	Preparation of Mixed fruit jam					
	Preparation of Fish pickle					
	Preparation of Shrimp wafer					
	Preparation of shrimp cutlet					
	Preparation of Fish cutlet					
	Preparation of Cleaning powder					
	Preparation of Nutritious food for infants					
TOTAL (d)		72	185	1237	1422	192

e. Extension workers

Discipline	Course title	No. of courses conducted	Male	Female	Total	SC
Fisheries	Shrimp farming	1	5	-	5	-
Agriculture	Milky mushroom cultivation	1	6	16	22	-
Home Science	Preparation of shrimp pickle	1	-	26	26	-
TOTAL (e)		3	11	42	53	-
GRAND TOTAL (a+ b+ c+ d+ e)		106	506	1579	2085	302

2. Conducting Seminars /Mahila meet/farmers meet etc

Sl.No.	Date	Nature of activity	Place
1.	18-6-2003	Farmers meet on Jasmine cultivation	Gramma panchayat, Edavanakad
2.	8-7-2003	Farmers meet on Jasmine cultivation	Krishi Bhavan, Elamkunnapuzha
3.	16-8-2003	Karshaka dinam programme	Thapovanam (NGO), Puthuvype
4.	18-8-2003	Farmers meet on Jasmine cultivation	Krishi Bhavan, Poothrikad
5.	20-8-2003	Farmers meet on Mushroom cultivation	Krishi Bhavan, Kunnathunad
6.	21-8-2003	Farmers meet on Mushroom cultivation	Krishi Bhavan, Mazhuvanoor
7.	23-8-2003	Farmers meet on Jasmine cultivation	Krishi Bhavan, Mazhuvanoor
8.	16-10-2003	The World Food Day Celebration	KVK, CMFRI Campus, Narakkal
9.	7-11-2003	Mahila meet on "Empowerment of rural women"	Gramma panchayat, Elamkunnapuzha
9.	12-12-2003	Mahila meet on "Empowerment of rural women"	Brindavan kudumbhashree unit, Arattuvazhi, Narakkal
10.	28-2-2004	National Science Day celebration	KVK, CMFRI Campus, Narakkal

3. Conducting camps, campaign and demonstration:

Sl.No.	Date	Nature of activity	Place
1.	23-10-2003	Pokkali paddy harvest mela	Demonstration fields of Vallampilly and Kattukal samajam, Elamkunnapuzha
2.	18-12-2003	Campaign on Vermitechnology	Vikas Trust (NGO), Elamkunnapuzha

4. Extension activities

4.1 Front line demonstration (FLD)

FLD on the following interventions were implemented during the period under report namely i. Integrated feed management in shrimp farms ii. Introduction of Pheromone trap for the control of beetle in coconut farm iii. Feasibility of rearing hybrid poultry layer bird *gramma shree* in backyard system.

4.2 On farm testing (OFT)

OFT on the following interventions were implemented during the period under report namely i. Freshwater ornamental fish culture ; ii. Introduction of improved high yielding variety of *Jasminum sambac*; iii. Testing and refining preparation of cleaning powder;

and iv. Testing and development of value added products from shrimp-preparation of wafer.

5. Establishment of income generating unit

5.1 Training and technical guidance in preparation of value added products from shrimp and fruits was given to the self help group " Karikonna kudumbha shree unit " ward No 11, Edavanakad gramma panchayat. A small scale unit has been started by this group for the preparation of shrimp pickle, mixed fruit jam, lime pickle, and garlic pickle. The inaugural sale of these products were held on 31-7-2003.

5.2 Training and technical guidance in preparation of 'Cleaning powder' was given to the self help group " Archana kudumbha shree unit " of ward No 7 and 8 of Elankunnapuzha gramma panchayat. A small scale unit has been started by this group for the preparation of cleaning powder. The inaugural sale of this product was held on 18-10-2003.

6. Project feasibility report

6.1 A project feasibility report on preparation and marketing of cleaning powder for Rs 2.5 lakhs (Working capital and infra structure for the preparation of 12000 Kg /year) to Soorya Kudumbhashree unit, Arattuvazhi, Narakkal to get financial assistance from gramma panchayat, Narakkal under women's self help group programme. A loan of Rs 1 lakh was sanctioned to this unit by the gramma panchayat, Narakkal through Federal Bank, Narakkal branch with a subsidy of Rs. 50,000/-.

6.2 A feasibility certificate on shrimp farming was issued to Shri A.K. Dinakaran, Ayanikkattu parambil, Panambukad, Cochin an ex trainee of this Kendra to get financial assistance/subsidy for shrimp farming from the Agency for Development of Aquaculture, Kerala (ADAK), Cochin.

6.3 A project report was given to Mayoori Kudumbha shree unit, East Appangadu, Narakkal for Rs 1.57 lakhs for availing loan from Narakkal Gramma panchayat under the self help group scheme to establish a unit to make and market shrimp pickle. The technical guidance to establish the unit will be given by the KVK.

6.4 A feasibility certificate was issued to Smt Moni George, Pullan House, Narakkal an ex trainee of this Kendra for availing financial assistance from Women's Development Corporation, Cochin to establish a unit for the cultivation of mushroom. The technical guidance to establish the unit will be given by the KVK.

Awards & Recognitions

The Central Marine Fisheries Research Institute has bagged the **Best Annual Report Award for the year 2001-2002** in the category of large ICAR research Institutes.

CMFRI bagged the **Town Official Language Implementation Committee Award** (Second Position) for the excellent implementation activities for the period 2002-2003.

CMFRI won the **ICAR Rajarshi Tandon Rajbhasha Award** (Second prize) for the Excellent Official Hindi implementation activities for the period 2002-2003.

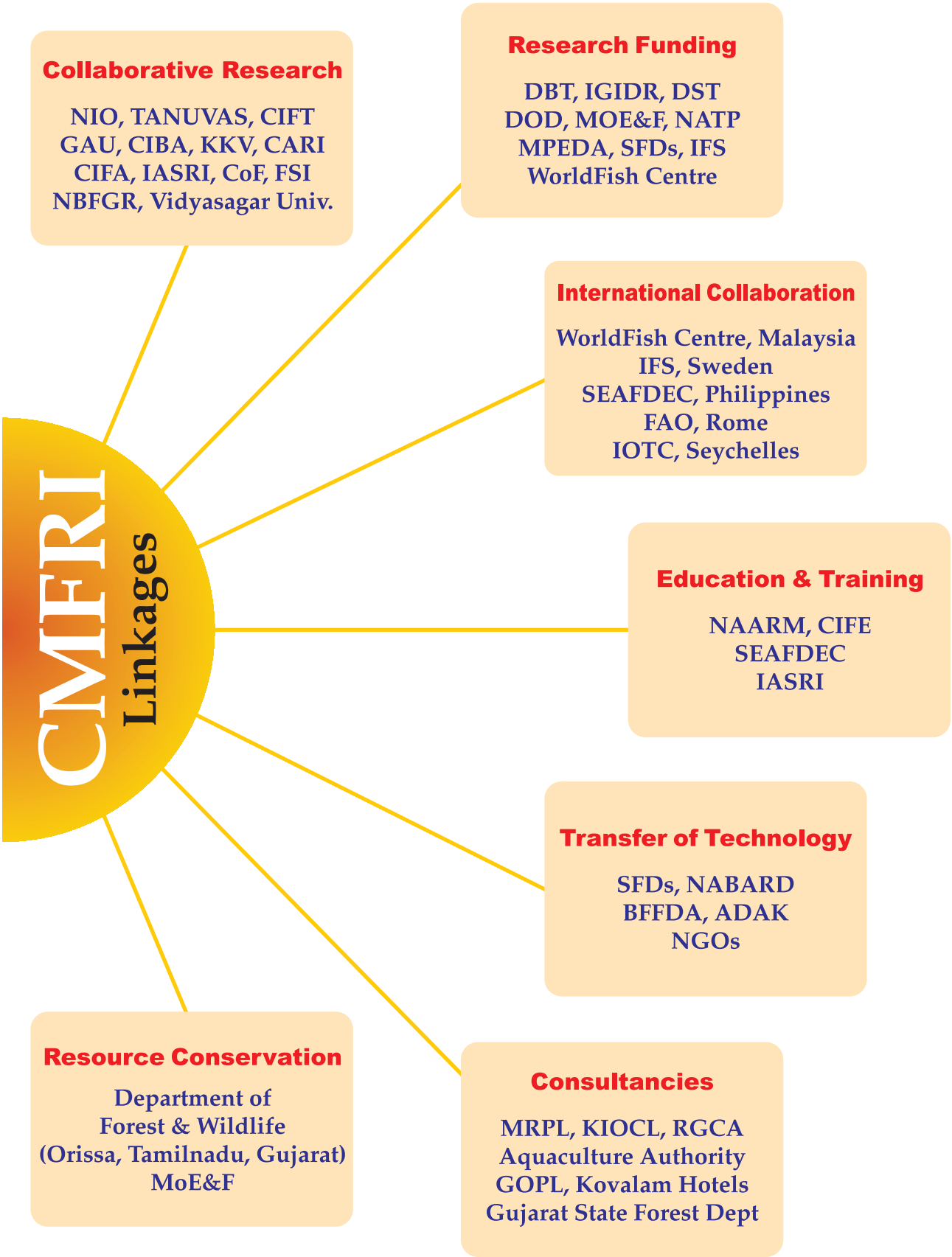
CMFRI won the **ICAR Rajarshi Tandon Rajbhasha Award** (First prize) for the Excellent Official Hindi implementation activities for the period 2003-2004.

Mr. G.S. Govindaraju, M.F.Sc. student (2000-2002 batch) was awarded the **DR. N.R. MENON AWARD** for the best M.F.Sc. thesis for the year 2003 for his dissertation entitled "Genetic profiling of Groupers of the genus *Epinephelus* (Family: Serranidae) using DNA-level markers" by the Professional Fisheries Graduates Forum. The research was carried out under the guidance of **Dr. P. Jayasankar**, Sr. Scientist, PNPD, CMFRI, Cochin.

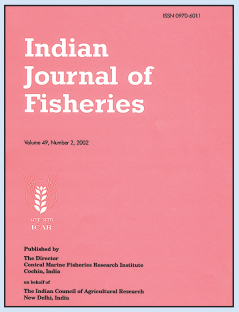
Mr. Joice Abhraham and **Ms. Neetha Susan David** (Ph.D. Scholars) secured the **Third prize** in the Inter-Collegiate Quiz Competition held University of Kerala, Triuvandrum on 15th March 2004 on the topic "Golden Jubilee Celebration of the Discovery of DNA double helix"

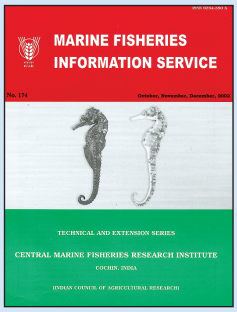
Prof. (Dr.) M.J. Modayil, Director receiving the best ICAR Annual Report Award for the year 2001-2002 from Dr. Mangala Rai, Director General, ICAR

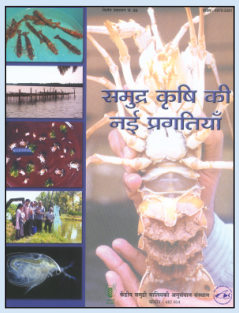
Prof. (Dr.) M.J. Modayil, Director, CMFRI receiving the Rajarshi Tandon Award of ICAR from Dr. R.C. Thomer, MP & Member of Parliamentary Committee on OL

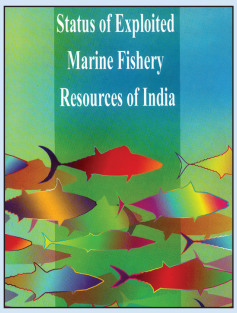

CMFRI Linkages
Collaborative Research
NIO, TANUVAS, CIFT
GAU, CIBA, KKV, CARI
CIFA, IASRI, CoF, FSI
NBFGR, Vidyasagar Univ.
Research Funding
DBT, IGIDR, DST
DOD, MOE&F, NATP
MPEDA, SFDs, IFS
WorldFish Centre
International Collaboration
WorldFish Centre, Malaysia
IFS, Sweden
SEAFDEC, Philippines
FAO, Rome
IOTC, Seychelles
Education & Training
NAARM, CIFE
SEAFDEC
IASRI
Transfer of Technology
SFDs, NABARD
BFFDA, ADAK
NGOs
Resource Conservation
Department of
Forest & Wildlife
(Orissa, Tamilnadu, Gujarat)
MoE&F
Consultancies
MRPL, KIOCL, RGCA
Aquaculture Authority
GOPL, Kovalam Hotels
Gujarat State Forest Dept

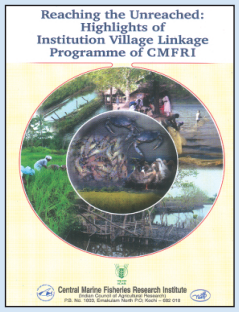
Publications

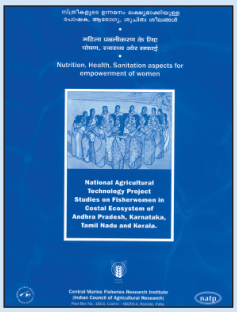












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- **Marine Fisheries Information Service - Technical and Extension Series**
- **CMFRI Newsletter**
- **Samudra Krishi ki Nayi Pragathiyam** - CMFRI special publication
- **Status of Exploited Marine Fishery Resources of India**
- **Matsyagandha** - CMFRI special publication
- **Reaching the Unreached : Highlights of Institution Village Linkage Programme of CMFRI**
- **Technology Diffusion - Training Programme under IVLP**
- **Training Material for Post Harvest Handling of Shrimp and Clam Products for Empowerment of Fisherwomen**
- **Need for Responsible Fisheries**
- **Our Fish... Our Wealth...** A movie on CMFRI
- **Mussel Farming in Open Sea & Estuaries in Karnataka Coastal Belts** - CD
- **Nutrition, Health, Sanitation aspects for empowerment of women**
- **Monsoon Season Post Harvest Losses in Traditional Fish Processing in India** - CD

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Approved Ongoing Projects

In-house Projects

SL. NO.	Project Code No.	Title of the Project
FISHERY RESOURCES ASSESSMENT DIVISION		
1.	FRA/ASSESS/01	Assessment of exploited marine fishery resources
2.	FRA/ASSESS/02	Stock assessment techniques for exploited marine fish and shellfish resources
3.	FRA/MOD/01	Predictive modelling in marine fisheries
4.	FRA/MOD/02	Determination of optimum sample size to estimate the catch and effort for use in marine fisheries
5.	FRA/MOD/03	Application of simulation models for marine fisheries management game
PELAGIC FISHERIES DIVISION		
6.	PEL/CAP/1	Development of management strategies for sustainable fishery of Sardines (*Sardinella* spp.)
7.	PEL/CAP/2	Development of management strategies for judicious harvesting of anchovies
8.	PEL/CAP/3	Development of strategies for rational exploitation of seerfishes
9.	PEL/CAP/4	Development of strategies for sustainable exploitation of tuna and billfish resources of Indian EEZ
10.	PEL/CAP/5	Development of management strategies and options for sustainable harvest of mackerels
11.	PEL/CAP/6	Development of management strategies and options for sustainable fishery of Bombay duck
12.	PEL/CAP/7	Monitoring of fishery and resource characteristics of exploited ribbonfish stocks and their management along the Indian coast
13.	PEL/CAP/8	Management of carangid resources of Indian EEZ
14.	PEL/BIOD/01	Taxonomy of marine pelagic finfishes
DEMERSAL FISHERIES DIVISION		
15.	DEM/CAP/01	Fishery and biological characteristics of the exploited stocks of elasmobranchs
16.	DEM/CAP/02	Fishery and biological characteristics of exploited resources of groupers, snappers, breams and catfishes
17.	DEM/CAP/03	Characteristics of exploited stocks of threadfin breams and silverbellies
18.	DEM/CAP/04	Fishery and biological characteristics of exploited stocks of croakers
19.	DEM/CAP/05	Biology and stock assessment of lizard fishes, bulls eye, pomfrets and threadfin resources
20.	DEM/CAP/06	Biology and fishery of flatfishes, flatheads, goatfishes and whitefish
21.	DEM/BIOD/01	Taxonomy of demersal fishes of India
22.	DEM/CUL/01	Marine finfish culture
CRUSTACEAN FISHERIES DIVISION		
23.	CRU/CAP/01	Investigations on the fishery and biological characteristics of exploited penaeid shrimp stocks
24.	CRU/CAP/02	Stock assessment and management of non-penaeid shrimp resources of India
25.	CRU/CAP/03	Investigations on the resource characteristics and development of management strategies for lobsters and crabs
26.	CRU/BIOD/01	Taxonomy of important crustaceans
27.	CRU/CUL/01	Broodstock development, selective breeding and restocking of marine shrimps
28.	CRU/CU//02	Breeding and seed production of lobster and crabs
29.	CRU/CUL/03	Organic farming of *P. semisulcatus*
MOLLUSCAN FISHERIES DIVISION		
30.	MOL/CAP/01	Fishery and biological characteristics of exploited cephalopod resources
31.	MOL/CAP/02	Assessment of bivalve and gastropod resources
32.	MOL/CUL/01	Technological feasibility studies and upgradation of molluscan mariculture
33.	MOL/CUL/02	Selective breeding of pearl oyster *Pinctada fucata* (Gould)
34.	MOL/CUL/03	Technological upgradation of molluscan seed production

35.	MOL/CUL/04	Marine pearl production through tissue culture and disease investigations on farmed bivalves
36.	MOL/BIOD/01	Taxonomy of marine molluscs

FISHERY ENVIRONMENT MANAGEMENT DIVISION

37.	FEM/01	Monitoring the environmental characteristics of the inshore waters in relation to fisheries
38.	FEM/02	Monitoring the state of health of the sea
39.	FEM/03	Resource assessment of seaweed and their culture
40.	FEM/04	Development of strategies for sea turtle and sea cucumber conservation
41.	FEM/05	Mariculture of live feed organisms
42.	FEM/BIOD/01	Taxonomy of marine zooplankton
43.	FEM/06	GIS based atlas on potential mariculture sites along Indian coasts

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

44.	PNP/NUT/01	Development of cost- effective and eco-friendly feeds for cultivable marine crustaceans and finfish by biotechnological interventions
45.	PNP/PAT/01	Disease monitoring and management in mariculture
46.	PNP/BIOT/01	Development of molecular and immuno- diagnostic kits for marine finfish and shellfish pathogens
47.	PNP/BIOT/02	Cryo-preservation of marine fish spermatozoa
48.	PNP/GEN/01	Population genetic studies in threadfin breams and sardines
49.	PNP/PHY/01	Development of cost effective low-stress methods for live transport of fish and crustacean

SOCIO-ECONOMIC EVALUATION AND TECHNOLOGY TRANSFER DIVISION

50.	SEE/PMS/01	Price behaviour and marketing system of marine fisheries in India
51.	SEE/ECO/01	Economics of marine fishing operations
52.	SEE/ITK/01	Indigenous knowledge systems and community based resource management in marine fisheries
53.	SEE/TOT/01	Evaluation of transfer of technology programmes in marine fisheries sector
54.	SEE/TOT/02	Livelihood analysis of coastal fisherfolk for technological empowerment

Sponsored Projects (National)

SL. NO.	Project Code No.	Title of the Project
1.	ERP/REV/01	Production of agar and sodium alginate from the sea weeds of Gulf of Mannar and Palk Bay
2.	ERP/REV/02	Commercial production of cultured pearls adopting onshore culture technology
3.	ERP/DST/01	Studies on the immuno-response during molt cycle in the spiny lobster
4.	ERP/APC/11	Application of trophic modeling for management of marine fisheries of Karnataka
5.	ERP/APC/12	Studies on incidence of toxic principle and parasites on seafood
6.	ERP/APC/13	Intensive culture of brine shrimp
7.	ERP/APC/14	Evaluation of genetic heterogeneity in marine ornamental fishes using molecular genetic markers
8.	ERP/APC/15	Investigations on reproductive dynamics of penaeid prawns in Mumbai
9.	ERP/APC/16	Increasing fish production through artificial fish habitats
10.	ERP/APC/17	Studies on the immune response in shrimp (*Penaeus indicus*)
11.	ERP/APC/18	Development of technology for sea farming of commercially important whelks *Babylonia spp*
12.	ERP/DOD/05	Investigations on the toxic algal blooms in the EEZ of India
13.	ERP/DOD/07	Development of acoustic techniques for fish and DSL biomass estimation
14.	ERP/DOD/08	Investigations on the effect of bottom trawling on the benthic fauna off Mangalore coast
15.	ERP/DBT/07	Studies on biotechnological aspects of disease management in aquaculture using immunostimulants
16.	ERP/DBT/08	Transfer of technology of seaweed culture for rural development
17.	ERP/KFD/03	Development of artificial reefs along the Kerala coast (Kannur)
18.	ERP/KFD/04	Survey, assessment and popularization of marine ornamental fishes along the north Malabar coast
19.	ERP/MEF/04	Studies on the biology, captive spawning and searanching of the sea horse
20.	ERP/MPD/04	Participatory Management and conservation of lobster resources along the south west coast of India
21.	ERP/DOD/09	Farming and Pearl production in Black lip pearl Oyster Pinctada margaritifera in Andaman waters

22.	ERP/DOD/10	Studies on marine mammals of Indian Exclusive Economic Zone and the contiguous seas
23.	ERP/DOD/11	Predictive modeling of marine fisheries of the south west coast of India

Sponsored Projects (International)

SL. NO.	Project Code No.	Title of the Project
1.	ERP/WFC/02	Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor households in Asia
3.	ERP/IFS/03	Environment impact assessment of suspended culture of the green mussel *Perna viridis* and the edible oyster *Crassostrea madrasensis* in a tropical estuarine system

NATP Schemes

SL. NO.	Project Code No.	Title of the Project
PSR Mode Projects		
1.	2090000002	Nutrition and pathology in mariculture
2.	2090000003	Shrimp and fish broodstock development and breeding under captive conditions
3.	2090000004	Breeding and culture of pearl oysters and production of pearls
4.	2090000008	Mussel Mariculture
5.	2090000009	Impact of dams on river run-off into sea and changes in nutrient and productivity profile of coastal waters
6.	2090000013	Mangrove ecosystem : Biodiversity and its influence on the natural recruitment of selectede commercially important finfish and shellfish species in fisheries
7.	2090000014	Studies of fisher women in coastal ecosystems of Andhra Pradesh, Karnataka, Tamil Nadu and Kerala
8.	2090000015	Augumentation of marine fish production in Lakshadweep
9.	2090000016	National resources management coral reef ecosystem
CGP Mode Projects		
10.	2090000007	Aquaculture, breeding and hatchery production of marine ornamental fishes with special reference to clownfishes and damselfishes
11.	2090000011	Designing and validation of communication strategies for sustainable/responsible fisheries - a co-learning approach
12.	2090000013	Broodstock development breeding, hatchery production and restocking of mud cabs
13.	2090000017	Development of a national referral laboratory for marine fish & shellfish micobial diseases
ATIC Project		
14.	2090000005	National Agricultural Technology Information Centre
IVLP Project		
15.	2090000010	Technology assessment and refinement in coastal agro-ecosystems
MM Project		
16.	2090000017	National Integrated Resources Management System
Strengthening of Library		
17.	2090000006	Library Information System

Consultancies & Patents

Consultancies during the year 2003-2004

Sl: No	Name of Client	Title of the Consultancy Projects	Duration	Amount
1	M/s Galfar International, Kundannor, Cochin.	Aquarium project at Kovalam Thiruvananthapuram.	June-03 to Sept-03	Rs. 1,50,000
2	M/s KIOCL, Mangalore.	Chemical parameters on the effluent and hydrobiological conditions in the effluent receiving water off Thanirbhavi. (Phase-7)	Sep-03 to Aug-04	Rs. 4,15.000
3	M/s GPOL, Mangalore.	Monitoring studies on the hydrobiological conditions in the Arabian Sea off Thanirbavi power plant facility (Phase-II)	Oct-03 to Aug-04	Rs. 3,00,000
4	M/s.Annamali University, Chidambaram, Tamil Nadu.	Aquarium project at Chidambaram	Feb-04 to Oct-04	Rs. 1,50,000
5	M/s. RGCA, Sirkazhi, Tamil Nadu.	Farming and fattening of spiny lobsters (Phase-II)	Feb-04 to Dec-05	Rs. 2,94,133
6	M/s MRPL, Mangalore.	Environmental monitoring in the Arabian sea off Chithrapur and effluent analysis. (Phase-8)	Feb-04 to Feb-05	Rs. 7,00.000
	Total amount			**Rs. 20, 09,133**

Patent applications filed during the year

S.No.	Name of Scientist	Name of Patent	Research Centre
1.	Dr. G. Gopakumar Principal Scientist	Hatchery technology for production of clown fish	Mandapam
2.	Dr. G. Gopakumar Principal Scientist	Hatchery technology for production of damsel fish	Mandapam
3.	Dr. S. Dharmaraja Principal Scientist	Pearl production technique through tissue culture in the pearl oyster *Pinctada fucata* and the abalone *Haliotis varia* and other pearl producing molluscs (under PCT regime)	Tuticorin

Important Meetings

RAC

The Ninth meeting of the Research Advisory Committee (RAC) of the CMFRI was held on 03.03.2004 at the Institute Headquarters, Cochin under the chairmanship of Dr. T.J. Pandian, Former National Professor. The Director of the Institute briefed the members on the overall progress made by the Institute during the year 2003-2004.

- The Director, CMFRI made a comprehensive presentation of the major achievements made by his team of scientists, and financial support received from ICAR and other funding agencies. The RAC noted that a number of proposals, have been forwarded for financial support during the financial year 2004-2005.
- The members of the RAC made certain observations and suggestions for greater success and achievements in various programmes undertaken by the 8 Divisions. The RAC was particularly impressed by the reduction in the in-house projects and the increase in the number of sponsored projects. It was further impressed by the overall performance of Molluscan Fisheries Division and Physiology Nutrition & Pathology Division. The RAC was happy to note the development of Duplex PCR Kit for rapid and cost effective diagnosis of white spot virus, floating fish feed, feed for fattening mud crab, tissue culture of marine pearls, and breeding of sand lobster.
- The Heads of the Divisions offered satisfactory clarifications for observations and suggestions made by the RAC. The Assistant Director General (M.Fy), ICAR mentioned that it is the governments' policy to double the production and productivity, and income of farmers during the Xth Plan. He also briefed the RAC on government policies. The RAC strongly recommends additional investments and personnel to such Divisions, which have mandate for aquaculture to increase productivity in marine food and ornamental fishes as well as pearls and medicinal organisms, to double or treble the revenue from marine fishery products within the plan period.

IMC

The 58th meeting of Institute Management Committee of CMFRI was successfully held on 29.5.2003. The meeting was Chaired by Prof. (Dr.) Mohan Joseph Modayil, and other members who attended were Sri C.K. Soman, Sr. T.C. Nagarajan, Sri. S. George, SFAO, CPCRI, Dr.N.G.K.Pillai, HOD, PFD, Dr.K.K Appukuttan, HOD, MFD, Dr. R. Sathiadhas, HOD, SEETTD and Sri. Viswambharan, Asst.Adm. Officer & Member Secretary. Approval of the minutes of the 57th meeting and review of the action taken on the items considered were made.

The 59th meeting was held on 4th March 2004 at CMFRI, Cochin under the Chairmanship of Prof. (Dr.) Mohan Joseph Modayil. The other members who attended the meeting were Dr. A.D.Diwan, ADG (M.Fy), Shri C.K.Soman, Sri. G.P. Sharma, SFAO, CPCRI, Dr. V.S. R. Murthy, HOD, DFD, Dr. N.G.K. Pillai, HOD, PFD and Sri. Charles Ekka, Senior Administrative Officer, & Member Secretary.

After a warm welcome by Chairman, Dr.V.S.R. Murthy presented a brief account of the Institute's Research activities. Dr. A. D. Diwan, requested the Management Committee to prioritize the activities. The minutes of

the 58h meeting of the IMC was approved after careful consideration and thereafter the review of the action taken on the items considered during the previous meeting was taken up.

SRC

The tenth meeting of the reconstituted Staff Research Council (SRC) of CMFRI was held at Cochin on 27th and 28th May, 2003. 65 Scientists who are Principal Investigators of ongoing in-house and sponsored research projects from the Headquarters, Regional and Research Centres of CMFRI presented the progress reports of the projects. The Chairman, Prof. (Dr.) Mohan Joseph Modayil in his welcome address emphasized the need for changes in our approach to research while addressing the issues confronting marine fisheries, mariculture technology development and its commercialization. He outlined the Research Progress Monitoring System formulated by the Director General, ICAR to monitor the research work carried out by individual Scientists of the ICAR. A Research Co-ordination and Management Cell and an Externally Funded Project Review Committee have been created to review the submission and monitoring of progress of research projects. Under each project the targets for the six-monthly period have to be fixed by each Scientist and the results obtained to be reported at the end of the period. Five new in-house projects were presented by the respective Principal Investigators for approval of the SRC. The SRC approved the project proposal pending modification of the budget. The progress under each project was critically evaluated and modifications made with regard to the technical programme.

The reconstituted 11th SRC meeting was held at Cochin on 9th and 10th March, 2004. 62 Scientists attended the meeting and presented the progress achieved under each inhouse and funded project. The Chairman Prof. (Dr.) Mohan Joseph Modayil informed that ICAR has passed the EFC memo of the Institute for Rs. 20.6 crores. The Chairman congratulated the Scientists who made significant contribution in developing technologies for slipper lobster breeding and tissue culture of pearls. The progress of work in each of the ongoing in-house and funded projects was critically evaluated and action plans were suggested. The Chairman in his concluding speech emphasized the need for strategic, anticipatory and interventional research in addition to monitoring and theoretical studies.

Participation of scientists in conferences, meetings, workshops, symposia and training in India and abroad

Prof (Dr.) Mohan Joseph Modayil, Director, participated in the following meetings

FAO sponsored National Workshop on 'Best practices in financial support for women in coastal fishing communities' and presented a paper, 1-4th July, 2003

Discussion regarding the outstanding advances and audit paras pertaining to CMFRI at New Delhi, 11th July, 2003.

'Special Fish Farmers Day' organized by CIFT, CMFRI, Kerala State Fisheries Department and private agencies at Poiyya fish farm in Mala (Trichur Dist.) and delivered keynote address on fish culture, fish diseases, their prevention and control, 15th July, 2003.

Discussion with NGOs and visits at Porayar, Chidambaram and Marine Biodiversity Centre, Annamalai University in connection with TIFAC Project of Department of Science and Technology 16-18th July, 2003

Discussion on research programmes with the Chairman, RAC of CIBA and Director, CIBA at Chennai,19th July, 2003

Meeting on entrusting the work related to recruitment/examination of administrative category posts on uniform pattern to ASRB, organized by ASRB at Project Directorate of Biological Control (PDBC), Bangalore, 23rd July, 2003

ICAR Institute's Directors' Meeting at New Delhi, 29-31 July, 2003.

Inaugural ceremony of the International Symposium on 'Freshwater prawns' at Cochin and chaired the session 'Biology and Capture Fisheries', 20 & 21 August, 2003

Book releasing ceremony of 'Seafood Safety' by Prof. K.V. Thomas, Hon'ble Minister for Fisheries & Tourism, Govt. of Kerala at CIFT, Cochin, 22nd August, 2003.

Valedictory function of the International Conference on 'Fish Diseases' organized by Department of Aquatic Biology, Kerala University and gave felicitations, 28th August, 2003.

Round Table Conference on Seaweed at National Academy of Agricultural Sciences, New Delhi 12th September, 2003.

Inaugurated the ICAR sponsored short-term course on 'Taxonomy and biodiversity of fishes and crustaceans' at College of Fisheries, Panangad and gave inaugural address, 17th September, 2003.

Presided over the *Kisan Mela* organized by CMFRI in order to understand the problems and issues facing the sector at Vizhinjam Research Centre of CMFRI, 29th September, 2003.

Meeting for discussions on the EFC Memos for X Plan at the SMD, New Delhi, 19-21st June, 2003

3rd Consultative Committee meeting of Fishery Survey of India held at Mumbai 25th June, 2003

Chaired the General Body meeting of Marine Biological Association of India held at CMFRI, 27th May, 2003.

First Directors' Management Workshop on 'Transience in Organizations' (Change Management) held at NAARM, Hyderabad, 27-30th October, 2003.

ICAR Revolving Fund Project Meeting at KAB-II and meeting with DG, ICAR along with DDG (Fy.) at New Delhi, 3rd November, 2003.

National Workshop on 'Methodologies for Prioritization of Fisheries Research in India' at NAARM, Hyderabad and presented the lead paper, 10th November, 2003.

Received the Rajershi Tondon Rajbhasha Award (2nd place) from Director General, ICAR for the excellent work done in Hindi under the ICAR Institutes during the year 2003, at New Delhi, 25th November, 2003.

DOD's Sagar Sampada Scientific & Technical Advisory Committee Meeting at Hotel Avenue Regent, Ernakulam, 3rd December, 2003

ICAR Regional Committee Meeting at IVRI, Bangalore, 29 and 30th December, 2003

Meeting convened by DDG (Fy.) alongwith the representatives from NBFGR, CIBA, CIFA and CIFRI at Delhi, 12th January, 2004

National Seminar on 'Advances in Coastal Agriculture and Value Addition from National Perspective' and presented a keynote address at CPCRI, Kasaragod, 21st January, 2004

Chaired the Third meeting of IX IJSC of CMFRI at Mandapam Regional Centre of CMFRI, Mandapam Camp, 24th January, 2004

Discussion on infrastructure requirements under the project 'Seed production in Agricultural Crops and Fisheries' at NBPGR, New Delhi, 24 -25th February, 2004.

International Conference and exposition on Marine Living Resources of India for Food & Medicine at Chennai, 27-29th February, 2004.

Seaweed 2004 : National Symposium and Exposition' at Ashir Bhavan, Ernakulam, 22-24th January, 2004

National Scientific Seminar in Hindi on 'Recent Advances in mariculture' at CMFRI, Cochin, 30th January, 2004.

Chaired RAC of CMFRI held at CMFRI Headquarters, Cochin, 3rd March, 2004.

Chaired SRC meeting of the Institute held at Cochin, 8 -11th March, 2004.

Board of studies meeting, Faculty of Fisheries at Fisheries College, Panangad, 16th March, 2004.

Scientists of the institute participated in the following conferences, meetings, workshops, symposia and training

Two day Workshop on Fisheries Resources Information System and Tools (FiRST) 12-13 August, 2003 at WorldFish Center, Penang, Malaysia - ***Dr. M. Srinath***

National Workshop on Methodologies for Prioritization of Fisheries Research in India 10-11 November, 2003 at NAARM, Hyderabad – ***Dr. M. Srinath, Smt. Sheela Immanuel, Dr. C. Ramachandran, Dr. Vipinkumar V.P***

Workshop on Community based certification programme in Kerala held under the auspices of IERSE, Nagercoil and WWF Nature – India, 6 February, 2004 - ***Dr. M. Srinath***, ***Shri. K. Balan***, ***Dr. T.V. Sathianandan, Dr. J. Jayasankar, Dr. Somy Kuriakose***

Attended the "Second Meeting of the Sagar Sampada Scientific and Technical Advisory Committee (SS-STAC)" organized by the Department of Ocean Development at Cochin on 3rd and 4th December, 2003 –***Dr. T.V. Sathianandan,***

Training programme on Feel (Facilitating Excellence in Effective Leadership) conducted at CMFRI, Cochin from 18-20 September, 2003 - ***Shri. Wilson T. Mathew, Dr. Somy Kuriakose, Smt. Mini K.G, Dr.K. K. Joshi, Dr. Josileen Jose, Smt. Rekha J. Nair***

'**Condensed Translation Training Course'** conducted by Central Translation bureau at CMFRI, Cochin from 18.8.2003 to 23.8.2003 ***- Dr. Somy Kuriakose, Smt. Mini K.G, Dr. Josileen Jose, Dr. P. Jayasankar***

National Tuna meet at Fishery Survey of India from 26-27 September, 2003 – Dr. N.G.K. Pillai, Dr. G. Gopakumar, Dr. C. Muthiah, *Dr. Somy Kuriakose, Dr. H.M. Kasim, Dr. A.K.V. Nasser, Shri M. Sivadas, Shri K.P. Said Koya, Dr. E.M. Abdussamad, Mrs. U. Ganga*

Meeting for discussions on the EFC Memos for X Plan and at the SMD at New Delhi, 19-21 June, 2003 – ***Dr. N. G. K. Pillai***

Technical Workshop of the Fisheries Resource Information System and Tools (FiRST) at WorldFish Center, Penang, Malaysia, 10-15 August, 2003 - ***Dr. N. G. K. Pillai***

Review meeting of the NATP Project 'Integrated National Agricultural Resources Information System' (INARIS) at CMFRI, Cochin, 30 September, 2003 - ***Dr. N. G. K. Pillai***

Training programme organized by Staff Training Centre, State Bank of India, 13 October, 2003 - ***Dr. N. G. K. Pillai, Dr. E.V. Radhakrishnan, Dr.T. S. Velayudhan***

Symposium on "Indian Marine Fishing Industry – challenges and opportunities" organized by Garware Ropes at Le Meridien, Cochin, 22 October, 2003 - ***Dr. N. G. K. Pillai, Dr. E.V. Radhakrishnan, Dr. (Mrs.) S. Sivakami***

Meeting of the Research Advisory Committee of Centre for Marine Living Resources and Ecology at Cochin, 11-12 December, 2003 – ***Dr. N.G.K. Pillai***

Seaweeds – 2004 – National Symposium and Exposition organized by CMFRI and Seaweed Research and Utilization Association at Cochin, 22-24 January 2004 – ***Dr. N.G.K. Pillai***, ***Dr. E.V. Radhakrishnan, Dr. A.A. Jayaprakash, Dr. (Mrs.) S. Sivakami, Dr. L. Krishnan, Smt. Grace Mathew, Smt. Rekha J. Nair, Dr. M. Rajagopalan, Dr. Reeta Jayasankar, Dr. Gulshad Mohamed, Dr. P. Kaladharan, Dr. Vipinkumar V.P, Smt N. Aswathy***

Meeting of the Committee constituted under the Chairmanship of Dr. J.B. Chowdhary, to evaluate the worth of the research work carried out by the Institute of DARE/ICAR at CTCRI, Trivandrum, 18 March 2004 - ***Dr. N.G.K. Pillai***

Two day workshop on "Responsible Fisheries Management – A co-learning Workshop" organised by MCITRA and CMFRI at Naduvattom, Kozhikode, 13-14 August 2003 – ***Dr. P.N.R. Nair, Dr. C. Ramachandran, Smt. Sheela Immanuel***

33rd meeting of "Town Official Language Implementation Committee at Calicut, 5 November, 2003 - ***Dr. P.N.R. Nair***

One day Seminar organised by Kerala Industrial Infrastructure Development Corporation and Infrastructure Development Finance Company Limited on 'Identification of infrastructure requirements for increasing exports from Kerala' at Calicut organised by Kerala Industrial Infrastructure Development Corporation and Infrastructure Development Finance Company Ltd., 15 November, 2003 - ***Dr. P.N.R. Nair***

39th meeting of STED project Task Force Committee in the chamber of District Collector, Calicut, 18 November, 2003 - ***Dr. P.N.R. Nair***

Fifth meeting of the Scientific Advisory Committee of KVK, under Indian Institute of Spices Research, Calicut at Peruvannamuzhi, 21 November, 2003 - ***Dr. P.N.R. Nair***

Seminar on 'Opportunities in Marine Biotechnology 'held at Visakhapatnam, organized by Industries and Commerce Department, Govt. of Andhra Pradesh, 11-12 December, 2003 - ***Dr. G. Gopakumar***

Ocean Life, Food and Medicine Expo – International Conference and Exposition on "Marine Living Resources of India for Food and Medicine" organised by Aquaculture Foundation of India, Chennai, 9 June, 2003 - ***Dr. H.M. Kasim, Dr.E.V. Radhakrishnan, Dr. E. Vivekanandan, Dr. M. Rajagopalan, Dr. L. Krishnan***

XIVth meeting of the Consultative Group for Chennai Base of Fishery Survey of India organised by Fishery Survey of India, Chennai, 23 June, 2003 - ***Dr. H.M. Kasim***

Meeting at Directorate of Fisheries, Teynampet, Chennai on 4th July 2003 to discuss the major issues concerning the coastal and marine environment and its living resources in the Tamil Nadu coast - ***Dr. H.M. Kasim***

Seminar on FISH FOR ALL by Dr. Meryl Williams, Director General of the World Fish Center, Malaysia, at M.S. Swaminathan Research Foundation, Chennai, 8th July, 2003 - ***Dr. H.M. Kasim***

Workshop of the NAT Project on Studies on Fisherwomen in coastal ecosystem of Andhra Pradesh, Karnataka, Tamilnadu and Kerala at CMFRI, Cochin, 7-8 August, 2003 - ***Dr. H.M. Kasim***

Meeting on Project Planning on Seawater Farming at M.S. Swaminathan Research Foundation, Chennai, 2nd September, 2003 - ***Dr. H.M. Kasim, Dr. R. Sathiadhas***

Workshop on Empowerment of Fisherwomen in Coastal Ecosystem of Andhra Pradesh, Tamil Nadu, Karnataka and Kerala at University Auditorium, Hyderabad, 13th October, 2003 - ***Dr. H.M. Kasim***

Workshop on Diversified Fishing Methods at Fishery Survey of India, Chennai, 20th October, 2003 - ***Dr. H.M. Kasim***

Sub-Regional Training Programme for Sustainable Management of Biosphere Reserves using Gulf of Mannar as a case study at M.S. Swaminathan Research Foundation, Chennai, 1st December, 2003 - ***Dr. H.M. Kasim***

XIX meeting of the ICAR Regional Committee at Project Directorate of Biological Control, Bangalore, 29-30 December, 2003 - ***Dr. H.M. Kasim***

National Workshop on 'Economic Development of Fisherwomen' organised by National Fishworkers Forum and Coastal Karnataka Fishermen Action Committee, 13-14 July, 2003 – ***Dr. Prathibha Rohit***

Seminar on 'Government Schemes in Fisheries Sector' conducted by Malabar Coastal Institute for Training, Research & Action at Calicut, 21 November, 2003 – ***Shri. M. Sivadas***

Meeting, Seminar and Quiz programme on 'Sustainable use and conservation of water' organized by the Dept. of Science & Technology in connection with the World Environment Day 2003, 5 June, 2003 – ***Shri. K.P. Said Koya***

Attended a Seminar on " Towards Sustainable Fisheries in Gujarat" conducted jointly by National Fish Workers Forum, Gujarat, International Collective in support of Fish Workers, Chennai and Protsahan, Trivandrum at Veraval on 16-5-2003 and 18-5-2003 – ***Dr. K.V. Somasekharan Nair***

Attended a Meeting of the ICAR Regional committee: VI: Covering the states of Gujarat, Rajastan and U.T. of Nagar Haveli/ Daman and Diu at Udaipur, Rajastan on 25-8-2003 and 26-8-2003 - ***Dr. K.V. Somasekharan Nair***

Attended 76th Foundation Course for ARS from NAARM, Hyderabad April 26 to Aug. 5, 2003 – ***Smt. Paramita Banerjee S***

Attended Phase IV of the 76th FOCARS – Policy level interaction at the ICAR Headquarters Head quarters New Delhi from Aug. 7 to Aug. 14, 2003 - ***Smt. Paramita Banerjee S***

Presented paper in Hindi at the National Seminar on "Fish Processing – Present Status and future trends" at CIFE (Deemed University, Mumbai) on December 19-20, 2003 - ***Smt. Paramita Banerjee S***

Seminar on *"Identification of New Research Issues in Marine Fisheries"*, CMFRI, Cochin, 30-31 January 2003: 60-64 – ***Dr. E.V. Radhakrishnan, Dr. Mary K. Manisseri, Dr. G. Nandakumar, Dr. Josileen Jose***

Attended the *7th* International Conference on Lobster Biology and Management, 8 -13th February, 2004 - ***Dr. E.V. Radhakrishnan***

Conducted one day workshops on 'Awareness building on lobster resources management and conservation' at New Ferry Wharf, Mumbai on 29.4.2003, at Veraval on 1.5.2003 and at Porbander on 2.5.03 - ***Dr. E.V. Radhakrishnan, Dr. V. D. Deshmukh, Dr. Zaffar Khan***

Conducted a meeting at Nagercoil on 30.10.03 regarding distribution of lobster traps to Enayam fishermen - ***Dr. E.V. Radhakrishnan***

Attended the 'Fish for All' – National Launch from 18-19 December, 2003 organised by M.S. Swaminathan Research Foundation - ***Dr. E.V. Radhakrishnan***

Attended the International course on "Alternative approaches to fisheries management at International Agricultural Centre (IAC) Wageningen University, Wageningen, The Netherlands during 6th October to 21st November 2003 - ***Dr. Josileen Jose, Dr. P. Laxmilatha, Dr. C. Ramachandran***

Participated in the workshop on "Gujarat Marine fisheries Act and Sustainable Fisheries" conducted at Veraval on 14.7.03 and Porbandar on 16.7.03 by the National Fish Workers Forum and "Protsahan" – ***Shri. Joe K. Kizhakudan***

Delivered a lecture on 'Crisis in fisheries sector' at Tata Institute of Social Sciences' Deonar, Mumbai, for Refresher course on 20th January 2003 – ***Dr. V.D. Deshmukh***

Participated as a subject expert in a series of meetings on 'Management of marine fisheries in Maharashtra State' at Commissionarate of Fisheries, Govt. of Maharashtra on 8th April & 29th July, 2003 - ***Dr. V.D. Deshmukh***

Attended workshop on "Strategies for development of Marine Fisheries in Andhra Pradesh at Visakhapatnam on 4.2.2004 conducted by Dept. of Fisheries, A.P - ***Dr. G. Maheswaradu***

International Training on "Alternative approaches to Fisheries Management" International Trainee6th October 21st November 2003 International Agricultural Centre, Wageningen, The Netherlands - ***Dr.P. Laxmilatha***

National workshop on Marine biodiversity and biotechnology organized by Dr.Babasahab Ambadkar Marathwada University on 20th January, 2004 at Ratnagiri - ***Dr. V. Kripa***

Seminar on prospects of mussel farming in Goa, 17-18 October 2003, Velha Goa, Goa – ***Dr. K.K. Appukuttan, , Dr. K.S. Mohamed, Dr. V. Kripa, Dr. P.K. Asokan***

International conference & exposition on marine living resources of India for food and medicine at Chennai during 27 – 29th February, 2004 – ***Dr. K.K Appukuttan, Dr. A.C.C. Victor, Dr. V. Kripa, Shri. I. Jagdis, Shri. B. Ignatius***

Winter School on Recent Advances in Mariculture Genetics and Biotechnology organized by the Institute at Cochin from 4 to 24th November 2003 – Dr***. V. Kripa, Dr. M.K. Anil, Dr. Shoji Joseph, Smt. Rekha J Nair***

Monitoring the concentration of cadmium, lead, copper and zinc from the coastal waters of India using Voltametric technique. International workshop on Marine Pollution and Ecotoxicology. February, 2004. NIO, Goa – ***Dr. M Rajagopalan***

Interlinking Of Rivers - the Probable Impact on Coastal Ecosystem and Fisheries. Paper presented at the ***Colloquium on Interlinking of Rivers in Andhra Pradesh*** organized by Visakhapatnam Chapter of Indian Meteorological Society, on 12 December 2003, Visakhapatnam - ***Shri. K. Vijayakumaran***

Meeting to consider the Risk Analysis Aspects for Issue of Sanitary Import Permits (SIP) on fish and fishery products organized by Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India held at Krishi Bhavan, New Delhi on 3rd June 2003 – ***Dr. R. Paul Raj***

31st Academic Council Meeting at Central Institute of Fisheries Education, Mumbai on 5th June 2003 - ***Dr. R. Paul Raj***

Chaired the session on "Nutrition, Feeds and Feed Additives" in the International Symposium on Freshwater Prawns organized by the College of Fisheries, Panangad from 21st to 23rd August 2003 - ***Dr. R. Paul Raj***

Workshops on 'Priorities of Research and HRD in Fisheries Biotechnology' at CCMB, Hyderabad, organized by the NAAS, during 24 -27th August, 2003 - ***Dr. R. Paul Raj, Dr. A. P. Lipton, Dr. P. Jayasankar***

Chaired the Sessions (i) Fisheries Management and Ornamental Fish Culture, and (ii) Nutrition and Pathology in the Ocean Life Food & Medicine Expo 2004, 27-29 February 2004 at Chennai - ***Dr. R. Paul Raj***

Co-ordinated the Winter School on ' Recent Advances in mariculture Genetics and Biotechnology' from 4th to 24th November 2003, organized by ICAR held at CMFRI, Cochin-14 - ***Dr. R. Paul Raj, Dr. P.C. Thomas, Dr. D. Noble, Dr. P. Jayasankar***

First Workshop on 'Studies on marine mammals of Indian EEZ and the contiguous seas' during 15 – 18th Oct, 2003 at CMFRI, Cochin – ***Dr. P. Jayasankar, Dr. M. Srinath, Shri. K. Balan***

Pre-cruise meeting on a pilot expedition for integrated studies to Southern Ocean on board FORV Sagar Kanya during 10 –11 Jan 2004 - ***Dr. P. Jayasankar***

Deputed for Pilot Expedition to Southern Indian Ocean onboard ORV Sagar Kanya as a member of four-member team of Center for Marine Living Resources and Ecology (CMLRE), Department of Ocean Development, Govt. of India, 3rd February to 8th March 2004 - ***Dr. P. Jayasankar***

Attended ICAR sponsored Short Term Course on "Taxonomy and biodiversity of fishes and crustaceans" on 20th Sept 2003 at College of Fisheries, Panangad, Kerala- ***Dr. E.V. Radhakrishnan, Dr. S. Sivakami, Dr. A.A. Jayaprakash***, ***Dr. P. Jayasankar***

Training programme on "GIS-based atlas on potential mariculture sites along Indian coasts" during 6 – 10 Oct 2003 at CMFRI, Cochin - ***Dr. P. Jayasankar***

Meeting of researchers in fish genetics and related aspects with Dr M V Gupta, ADG & Coordinator, INGA, World Fish Center at CIFRI, Barrackpore – ***Dr. P. Jayasankar***

International Symposium on Freshwater Prawns organized by College of Fisheries, Panangad from 21st to 23rd August 2003 – ***Dr. (Mrs.) K.S. Shobhana***

Advance Training in Shrimp and Grouper Virology at SEAFDEC, Iloilo, Philippines from 5th – 21st November 2003 - ***Dr. (Mrs.) K.S. Shobhana***

Training on "Human Resource Development in Veterinary Biotechnology at IVRI, Izatnagar from 3rd February to 29th March 2004 - ***Dr. (Mrs.) K.S. Shobhana***

Attended Winter School on 'Recent Advances in Mariculture Genetics and Biotechnology' from 4th to 24th November 2003 – ***Dr. (Mrs.) Imelda Joseph***

Attended and delivered the inaugural address in the NATP Training Programme on "Post Harvest Processing – Value addition of Fish, Fruits and Vegetable Processing and Fine arts" conducted by Madras Research Centre of CMFRI at Kovalam Field Laboratory. 2-4 December – ***Dr. R. Sathiadhas***

Attended and presented the progress report of the IVLP annual report at the review workshop at CRIDA, Hyderabad , 22-24 December - ***Dr. R. Sathiadhas***

Attended the national workshop on Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor households in Asia at NCAP New Delhi during 29th to 30th January 2004 - ***Dr. R. Sathiadhas***

Attended the *Swadesi* Congress meeting at St. Teresa's college, Cochin on 28.8.03 – ***Dr. (Mrs.) S. Ashaletha***

Attended Refresher course on *Education* at the Academic Staff College, Kerala University from 26th December to 16th January 2004 - ***Dr. (Mrs.) S. Ashaletha***

Attended and presented the annual report of the IVLP project in the Annual Review Meeting conducted at IISR, Kozhikode, from 22 to 24th , September organised by the Zonal Coordination Unit, Bangalore – ***Smt. Sheela Immanuel***

Attended the National workshop cum training on "Recent Developments in Bio-informatics and statistics in aquaculture" during Feb. 10-13 , 2004 at CIFA, Bhubaneswar **– *Dr. C. Ramachandran***

Attended training programme in official language on "Post harvest technologies in marine and inland fishes of India, from August 25th to 4th September conducted by CIFT, Cochin - ***Dr. C. Ramachandran, Smt. Aswathy N.***

Attended and presented the annual report of the ATIC in the annual review meeting conducted at KVK, Pondicherry, from 16 to 17th , September organised by the Zonal Coordination Unit, Bangalore - ***Dr. Vipinkumar V.P.***

Organised two interactive discussions with the farmers in ATIC on 18.10.2003 and 19.10.2003 - ***Dr. Vipinkumar V.P.***

Workshops Seminars Summer Institutes Farmer's Day Organised

Under the MPEDA funded project, 'Participatory management and conservation of lobster resources along the southwest coast of India' 40 CIFT designed lobster traps were distributed free to the fishermen of Khadiyapatnam, Kanyakumari District in a function held on 11 June, 2003. The function was presided over by Rev. Fr. Joy, Parish Priest, Khadiyapatnam in the presence of Prof. S. Lazarus, Emeritus Scientist, MS University, Tirunelveli and Sri.P. Pravin, Senior Scientist, CIFT, Cochin. In another function held at Enayam fishing village, Kanyakumari District, Tamilnadu on 19 November 2003, 40 lobster traps were distributed to the fishermen. The function was presided over by Rev. Fr. Stephen, Parish Priest, Dr.E.V.Radhakrishnan, HOD, CFD and Principal Investigator of the project, CMFRI, Dr. B. Meenakumari, Principal Scientist, CIFT, Prof. S. Lazarus, and Sri Jayabalan, Deputy Director of MPEDA. Sri. Mano Thangaraj, Enayam Panchayat President distributed the traps to the fishermen. The objective of the trap distribution programme is to wean the fishermen from using the destructive trammel nets for lobster fishing. The fishermen found the lobster traps effective in catching lobsters and also suggested some modifications in the design.

The CMFRI, Cochin organized the GIS Software Training during 6-10 October at FRAD, Cochin and imparted training to 12 scientists of FRAD, FEMD, MFD, PNPD

The first workshop to impart training on marine mammal identification organized by CMFRI, during 15-18 October 2003 at FEMD, Cochin

The final workshop on NATP Project on Mangrove Biodiversity organized by CMFRI, in collaboration with CARI, Port Blair

The final workshop on NATP Project on Impact of Dams organized by FEM Division at Mangalore during 23-24 December 2003

The CMFRI in collaboration with SRUA, Mandapam Camp organized National Symposium and Exposition on Sea Weeds during 22-24 January 2004 at Cochin

Five days training programme on 'Empowerment of Coastal Communities' in Payyannur, Kannur during 24th - 28th March 2003.

A four days training programme on Post Harvest Management of Shrimp and Clam products was conducted for 40 women fisherfolk at Thekkumbagam., 20-23, Dec 2003.

Three days training programme on Empowerment of Fisherwomen at Anjalikkadu. 25 to 27 September, 2003.

A three days training programme on "Post harvest management of clam and shrimp products " was organised from 28th to 30th August 2003 at Aroor and Anjillikad under NAT project on Studies on fisher women in coastal eco system of Andhra, Karnataka, Tamil Nadu and Kerala.

A two days training programme on Responsible fisheries was conducted at HRD centre ,Kozhikode under the NATP (CGP) project on "Designing and validation of communication strategies –A co learning approach" in collaboration with "MITRA" an NGO from 12.8.2003.

A training programme cum seminar on 'Crab Fattening' in collaboration with State Dept. of Fisheries, Mangalore, KVK(University of Agricultural Sciences), Brahmavar and BFDA, Uduppi, to the fisherfolk of Mangalore

Rev. Fr. Stephen, Parish Priest, Enayam Fishing Village distributing CIFT-designed lobster traps to the a fisherman

Dr. S. Ayyappan, DDG, Fisheries Division, ICAR addressing the valedictory function of National Symposium and Expo, *Seaweeds - 2004*

Shri. Anil Kumar Dube, Director (Hindi), ICAR receiving a copy of *Matsyagandha* from Shri. Thomas Mathew, CCDO, Coconut Development Board, Cochin

under the project, "Alternate Livelihood Options for Fisherfolk through Crab Fattening". More than fifty farmers attended the programme. Consequently, two on farm demonstrations on crab fattening were started in Mangalore under the project

Two training cum demonstration programmes in Karnataka coasts one for raft culture in open sea at Majaji of Dandebag and one for rack culture at Sunkeri of Kali Estuary under an inter-disciplinary project, 'Dissemination of Mussel Farming Technology through Self Help Groups in Northern Karnataka, Goa and Maharashtra'

PNPD Organised a 21 day winter school on "Recent Advances in Mariculture Genetics and Biotechnology" in which 21 university teachers and scientists from ICAR participated.

PNPD organised a training programme on "Histopathological Techniques in Disease Diagnosis" for officers of MPEDA and one private entrepreneur.

Distinguished Visitors

Cochin

Honourable Members of Parliamentary Standing Committee on Agriculture, Dr. A.K. Patel, Smt. Jamana Devi Barupal and Shri. Chintaman Wanaga

Dr. Mali Boonyaratpalin, Fisheries Resource Management specialist and Dr. Supis Thongrod, Senior Fisheries Biologists from Department of Fisheries, Thailand

Dr. A.G. Sawant, ASRB Member

Shri. Sudhir Mankad, IAS, Additional Secretary and Financial Advisor, Ministry of Agriculture

Committee on Private Members Bills and Resolution of the Kerala Legislative Assembly.

Parliamentary Standing Committee

Mr. Najafi, Minister of Agriculture, Iran

Dr. I.V. Subba Rao, Member, High Power Committee to evaluate the research work in the ICAR Institutes

Dr. John Warford and Dr. Konda P. Reddy from Tropical Marine Science Institute, Singapore

Dr. P. Natarajan, Professor, Kerala University

Dr. K. Ramalingam, Professor,, Govt. Arts College, Chennai

Dr. M.J. Chandragowda, Sr. Scientist, ICAR TOT Projects, Z.C. Unit, Bangalore

Dr. M.V. Kulsy, FAO Consultant

Dr. J.P. Mittal, National Co-ordinator (ITD), ICAR, New Delhi

Veraval

Smt. Bhavanaben Devaraj Chikhaliya, Hon'ble Minister of State for Tourism and Culture, Govt. of India

Shri. Govindbhai Parmar, MLA – Talala (Gujarat)

Shri. Madhabhai Boricha, MLA – Keshod (Gujarat)

Krishi Vigyan Kendra, Narakkal

Shri C.M. Devassy, Block Panchayat President, Vypeen Block, Kuzhipilly

Dr K.S. Purushan, Associate Professor, Fisheries Station, Kerala Agricultural U;niversity, Puthuvype, Vypeen.

Vizhinjam

Dr. S. Ayyapan, Deputy Director General (Fy.), Indian Council of Agricultural Research, New Delhi

Shri. G. Chandrasekhar, Under Secretary, DARE, New Delhi

Lt. Gen. Narendra Aul, COS HQ Northern Command

Dr. M. Lakshmanan, Former Vice-Chancellor of Madurai Kamaraj University, Madurai

Shri. S.T. Kharcha, Judge Bombay High Court

Mr. Martin Scharugel from Germany travelling around the world on motorbike

Shri. Kanti Desai, Honorable Minister for Education, West Bengal

Visit of Parliamentary Standing Committee to ATIC

Visit of Minister of Agriculture, Iran

Dr. I.V. Subba Rao, Member, ICAR High Power Committee and Former Vice Chancellor, Acharya NG Renga Agricultural University, Hyderabad.

Minicoy

Dr. T.K. Pal, Joint Director & Team, Zoological Survey of India, Kolkata

Shri. T.K.N. Nambiar, Administrative Officer ,CPCRI, Kasaragode

Shri. K.M. Johnson, Lecturer, Mar Elias, H.S.S. Kottappady, Kothamangalam

Shri. M. Yusuf, Principal, P.N.M.,G.H.S.S., Chirayinkeezhu, Trivandrum

Tuticorin

Shri. M.S.N. Sastry, Chief General Manager, HWP, Tuticorin.

Mandapam

Prof. T.J. Pandian, Madurai Kamaraj University, Madurai

Dr. V. Sampath, Director, Department of Ocean Development, Chennai

Dr. M.K. Srivastava, Director, DAC, Ministry of Agriculture, Govt. of India, Krishi Bhavan, New Delhi

Ms. M.P. Nirmala, I.A.S., Director of Fisheries, Chennai

Dr. S.D. Sharma, Director, IASRI, New Delhi

Dr. O.P.S. Sharma, Principal Scientist & Head (CP), ICAR Unit-IGFRI, Jhansi

Chennai

Dr. R.J. Asari, Conservator of Forests, Marine National Park, Jamnagar

Shri. Viswanath A. Shegaonkar, Secretary to Department of Animal Husbandry & Fisheries, Govt. of Tamil Nadu and Dr. M. Sakthivel, Chairman, AFI

Kakinada

Dr.(Mrs.)Vijaya Khader, Dean, Faculty of Home Science, & Principal Investigator, Studies on Fisherwomen in the Coastal Ecosystems (NATP)

Shri.R.C.Sinha and Shri.Shaji of Central Institute of Fisheries and Nautical Engineering (CIFNET), Visakhapatnam with 40 trainees

Dr.P.K.Prathan of College of Fisheries, Central Agricultural University, Tripura with 30 final year B.F.Sc., students on study tour

Dr.B.M.Tiwari of Kolkotta Centre of Central Institute of Fisheries Education (CIFE), Mumbai with 24 students of PG Diploma Course

Visakhapatnam

Shri. G.V.S. Prasad, CEO, Golden Aquafarms, Thimmepuram

Shri. P. Narayana Rao and Shri. K. Prasad, Aquafarm, Katrameri

Karwar

Professor Ravichandra Reddy, Prof. Jayaprakash and Dr. Bela Zutshi, alongwith 56 post graduate students, Department of Zoology, Bangalore University

Personnel
(Managerial Position only)

Director	**Prof. (Dr.) Mohan Joseph Modayil**
Heads of Divisions	
Fishery Resources Assessment Division	Dr.M. Srinath
Pelagic Fisheries Division	Dr.N. Gopalakrishna Pillai
Demersal Fisheries Division	Dr.(Mrs.) S. Sivakami
Crustacean Fisheries Division	Dr.E.V. Radhakrishnan
Molluscan Fisheries Division	Dr.K.K. Appukuttan
Fishery Environment Management Division	Dr.M. Rajagopalan
Phisiology, Nutrition and Pathology Division	Dr.R. Paul Raj
Socio-Economic Evaluation & Technology Transfer Division	Dr.R. Sathiadhas
Sr. Administrative Officer	Shri K. L. Meena
Sr. Finance & Accounts Officer	Shri A.V. Joseph
Administrative Officer	Shri N. Viswambharan
Scientists-in-Charge of Regional/Research Centres	
Mandapam Camp	Dr.N. Kaliaperumal, PS
Chennai	Dr.H. Mohamed Kasim, PS
Tuticorin	Dr.A.C.C. Victor, PS
Kakinada	Dr.R. Narayanakumar, PS
Karwar	Dr.V.S. Kakati, PS
Mangalore	Dr.C. Muthiah, PS
Veraval	Dr.K.V. Somasekharan Nair, PS
Vizhinjam	Dr.A.P. Lipton, PS
Mumbai	Dr.V.D. Deshmukh, PS
Minicoy	Shri.K.P Said Koya, Scientist
Visakhapatnam	Dr.G. Syda Rao, PS
Calicut	Dr.P.N. Radhakrishnan Nair, PS
Krishi Vigyan Kendra	Dr.P.K. Martin Thomas, Technical Officer

Special Infrastructure Development

Atomic Absorption Spectrophotometer in operation

Cochin

Two additional floors (5th and 6th) have been added to the CMFRI Headquarters building. The Director's Office, Technical Cell and RCMC, Committee room, the Administrative offices and the Central analytical laboratory are accommodated on the 5th floor. The Marine Museum, the Conference Hall, the Audit and Accounts Section, Marine Biodiversity Division and the Mariculture Division are located on the sixth floor. An Atomic Absorption Spectrophotometer has been added to the Central laboratory.

The Departmental Canteen have been shifted on the northern part of the main building with better amenities.

Mandapam

The experimental shrimp hatchery has been shifted to an adjacent new facility. A new hatchery has also been constructed for breeding and hatchery production of marine crabs.

Official Language Implementation 2003-2004

The action plan for the year has been streamlined as per the Official Language policy. The highlights are as follows:

A. New initiatives and programmes

1. Competancy development

· Realising the importance of employees in carving the functions of the Institute and to analyse their interest and use of Hindi at the functionary level proforma studies and personal discussions were conducted through the *Chal Hindi Anubhag* (a campaign of meeting & discussing with the staff). The analysis revealed that all employees of the Institute are undertaking some or other kind of work in Hindi. 59% of the personnel are undertaking 20-99% work in Hindi and the rest 41% 1 to 20%.

The notable contributions in implementation are:

i. Marginal increase of 1.6% in Hindi correspondence from 38.6% to 40.2%..

ii. Marginal increase of 2% in the file notings from 18 to 20%.

iii. Saturation in the inservice training courses like Hindi, typewriting and stenography . 4 personnel were passed out during the year.

iv. Follow up actions and 100% implementation of assurance given to Parliamentary Committee on Official Language.

v. Submission of 39 page Hindi document to the Parliamentary standing Committee on Agriculture and the related subjects.

vi. Preparation of 12 MFSc/Ph.D thesis abstracts.

6. Incentives:

6 Officers and staff participated in the Hindi training programmes conducted by other Institutes. The employees were encouraged to participate under various events by giving special incentives as under

1) Original work in Hindi - 8 prizes of total Rs. 18,000

2) Best article written - 1 prize of Rs. 500

3) Best presentation made - 1 Prize of Rs. 500

4) Best poster Designed - 3 prizes of Rs. 1500

7. The Recognitions

o The Cochin TOLIC awards of the year 2001-2002 (Ist position) and 2002-2003 (IInd position) for excellent Hindi implementation activities. (awarded on 2003-04)

o The best house journal award (IIIrd) of TOLIC for *Matsyagandha 2002*. (awarded on 2003-04)

Dr. L. Krishnan, Principal Scientist receiving Cochin TOLIC Rajbhasha Shield from Shri. B.M. Jindel, Chief Commissioner of Income Tax

कार्यकारी सारांश

देश की समुद्री मात्स्यिकी संपदाओं का टिकाऊपन सुनिश्चित करने के उद्देश्य से केंद्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान वर्ष 2003-04 की अवधि के दौरान 51 गृहांदर परियोजनाओं, 19 प्रायोजित परियोजनाओं, 13 राष्ट्रीय कृषि प्रौद्योगिकी कार्यक्रम परियोजनाओं, 2 आवर्ती परियोजनाओं और 6 परामर्श परियोजनाओं के अनुसंधान कार्यों में लगा हुआ है। संस्थान की मुख्य कार्यविधियों का सारांश यहाँ दिया जाता है।

प्रग्रहण मात्स्यिकी

वर्ष 2003 के दौरान 2.66 मिलियन टन समुद्री मछली पकड आकलित हुई, जो पिछले वर्ष की तुलना में 1.5% अधिक थी। इस वृद्धि का कारण तारली, अन्य तारलियों, बम्बिल, क्रॉकेर्स, बांगडा, सुरमई, पेनिआइड झींगों और शीर्षपादों की वर्द्धित पकड था। पेर्च, फीतामीन, करंजिड और नोन-पेनिआइड झींगों की पकड में सीमांत घटती हुई।

कुल मछली पकड का 67% पश्चिम तट से हुआ। इसमें यंत्रीकृत सेक्टर का योगदान 66%, मोटर लगाए गए यानों के सेक्टर का 27% और कारीगरी सेक्टर का योगदान 7% था। एक सामान्यीकृत मात्स्यिकी विकास नमूने से यह व्यक्त हो जाता है कि समुद्री मात्स्यिकी संपदाओं का 40% प्रौढ़ स्थिति में है या तो जीर्णता की स्थिति में है। कुल 3.16 मिलियन टन शक्य प्राप्ति आकलित की गई है।

सारडिनेल्ला जातियों की कुल पकड़ 4.8 लाख टन थी जिसमें 3.7 लाख टन तारली और बाकी अन्य तारलियाँ थी। बारिश के वक्त तारलियों के समय श्रेणी आंकडे (time series data) की प्रवणताओं पर किए गए अध्ययन से तारली और बारिश के बीच का सह संबंध व्यक्त हो गया है। वर्तमान में इस जाति का विदोहन अधिकतम वहनीय पकड (msy) के स्तर तक किया गया है और मात्स्यिकी के नियमन के लिए विशेष प्रकार के प्रबंधन विकल्प की ज़रूरत नहीं है। तारलियों की पकड़ पर मानसून समय के आनायन-निरोध का कोई असर नहीं पडा है। आधारभूत आकृतिमान विश्लेषण से उप वयस्कों में झुंडों के खडा विसंयोजन और वयस्कों में झुंडों के रेखित विसंयोजन का रूपायन दिखाया पडा, जिस से वयस्क जातियों के मिश्रण की साध्यता का संकेत मिलता है।

केरल, कर्नाटक और महाराष्ट्र में ऐंचोवियों की वर्तमान पकड़ इष्टतम स्तर से कम थी। ऐंचोवियों का आकलित उत्पादन 0.79 लाख टन था।

दोनों तटों में किंग सीर (*स्कोम्बरोमोरस कमेर्सन*) और स्पोटड सीर (*एस. गटाटस*) के समग्र विदोहन का अनुपात उच्चतम था। इस से यह संकेत मिलता है कि वर्ष 2003 के दौरान इन जातियों का मत्स्यन दबाव भी ज़्यादातर था। पूर्व तट पर छोटी जालाक्षियों वाले गिल जालों से कम आकार वाली (<340 मि मी) मछलियों को अधिक रूप से पकड़ा गया। सुरमइयों की पकड़ में हुई वृद्धि और छोटों के उत्पादन का आकलन बडी जालाक्षियों के गिल जाल और कांटा डोर के प्रयोग से किया जा सकता है। आगे इन का प्रयोग अपतटीय समुद्र में अविदोहित मछलियों की पकड के लिए सज्जित किया जाना आवश्यक है।

वर्ष 2003 के दौरान ट्यूना और बिलफिशों की कुल पकड 0.56 लाख टन आकलित की गई थी जो पिछले वर्ष की पकड से 4% अधिक थी। प्रमुख संभार ड्रिफ्ट गिल जाल था। बांगडों की आकलित पकड 1.12 टन थी जो पिछले वर्ष की अपेक्षा अधिक थी। मुख्यतः सभी केंद्रों में इस जाति का साधारण विदोहन हुआ और कालिकट में वलय संपाशों से इस का अति विदोहन हुआ है।

रिपोर्टाधीन वर्ष के दौरान मात्स्यिकी में बंबिलों के किशोरों की ज़्यादातर उपस्थिति दिखाई पडी। अतः जालाक्षियों का कडा नियमन लगाया गया। पश्चिम तट पर अत्यधिक मत्स्यन दबाव के कारण फीतामीन *ट्राइक्यूरस लेप्टयूरस* के स्टाक में उल्लेखनीय कमी हुई। अधिकांश केंद्रों में मछलियों की कम लंबाई और प्राप्ति दर रिपोर्ट की गई। करंजिडों की कई जातियों में विदोहन अधिकतम वहनीय पकड के निकट ही था। मात्स्यिकी में वर्ष 1995 से लेकर घटती की प्रवणता दिखाई पडी।

वर्ष 2003 के दौरान भारत की कुल समुद्री मछली पकड़ का 2.19% उपास्थिमीन था, जो पिछले वर्ष की अपेक्षा 2.37% की सीमांत घटती का सूचक भी था। रे मछलियों की पकड में बढ़ती हुई, फिर सुराओं और स्केटों की पकड में घटती भी हुई। रे मछलियों में मादा मछलियों की अधिकता दिखाई पडी। गर्भावधि के दौरान मादा और नर मछलियों के आकार में भिन्नता देखी गई। वर्ष 2003 में ग्रूपरों की पकड 15222 टन थी और यह वर्ष 2002 की तुलना में 40% कम थी। पकड में मुख्यतः किशोर और अप्रौढ़ मछलियाँ थी और पश्चिम तट में *एपिनिफेलस डयाकान्तस* अधिक मात्रा में देखी गई।

वर्ष के दौरान उत्तरी समुद्रवर्ती राज्यों में शिंगटियों की पकड़ में उल्लेखनीय वृद्धि हुई। सूत्रपख ब्रीमों की वृद्धि, मृत्युता और विदोहन स्तर पर किया गया अध्ययन इन मछलियों का इष्टतम विदोहन सूचित करता है। क्रॉकेर्स की पकड में 1.52% बढ़ती हुई और पकड में इस कुटुम्ब की पूरी 18 जाति मछलियाँ मौजूद थीं। किशोर मछलियों की भारी पकड की वज़ह से पूरे वर्ष के दौरान सयनिडों की पकड में घटती दिखाई पडी। पूर्वी तट पर तुम्बिलों की जाति विविधता बहुमात्रा में दिखाई पडी। अधिकांश केंद्रों में यह संपदा भारी मत्स्यन दबाव पर थी। विशाखपट्टणम में *सौरिडा अंडोस्क्वामिस* का अति विदोहन हुआ। वर्ष

2003 के दौरान चपटी मछलियों की पकड कुल समुद्री मछली उत्पादन का 1.8% थी। कालिकट में *सिनोग्लोसस माक्रोस्टोमस* का स्टॉक निर्धारण अध्ययन करने पर व्यक्त हो गया कि यह मछली जाति कम विदोहित है। इसी प्रकार चेन्नै में भी गोट फिश *यूपेनिअस टीनियोप्टीरस* का विदोहन भी अधिकतम वहनीय पकड से कम है। मलबार क्षेत्र में चपटी मछली *ईसोपिया कोर्नूटा* की असाधारण उपस्थिति रिपोर्ट की गई।

मांगलूर तट पर नितलस्थ आनायन से वहाँ के टी एस एस, विलीन ओक्सिजन, फोस्फेट, सिलिकेट, क्लोरोफिल और विलोप गुणांक (extinction coefficient) में परिवर्तन रेकोर्ड किया है। गहरे समुद्र की अपेक्षा उथले जल में मत्स्यन करने पर उपयोगशून्य और किशोर मछलियाँ अधिकतम मात्रा में दिखाई पडती है। चेन्नै में कृत्रिम मछली समुच्चयन उपाधियों द्वारा लगभग 1,11,197 रुपए के 2694 कि ग्रा का मछली उत्पादन हुआ जिसमें मुख्यतः स्नापेर्स, करंजिड्स, ब्रीम्स और पोमासेन्ट्रिड्स मौजूद थे।

कवचप्राणी मछलियों की पकड़ में वर्ष 2003 के दौरान कुल वार्षिक समुद्री मछली उत्पादन का 16.5% बढ़ती दिखाई पडी। इस में प्रमुख मछली वर्ग पेनिआइड (49.6%) और नोन-पेनिआइड (31.7%) झींगे थे। कालिकट में चिंगटों की विदोहन दर एम एस वाइ के निकट थी। आंध्रा तट पर गभीर सागर चिंगटों की अच्छी मात्रा में पकड़ हुई। *असेटस* जातियों की कम पकड़ की वज़ह से डोल जाल मात्स्यिकी में नोन-पेनिआइड चिंगटों की घटती दिखाई पडी। गुजरात में वर्ष 2003 के दौरान महा चिंगट पकड में हुई घटती चिंताजनक थी। छः केंद्रों में चिंगटों, महाचिंगटों, कर्कटों और स्टोमाटोपोडों का वर्गिकीय अध्ययन जारी रखा।

वर्ष 2003 के दौरान अखिल भारतीय शीर्षपाद उत्पादन में वर्ष 2002 की अपेक्षा 22% की बढ़ती हुई जो महाराष्ट्र में हुए शीर्षपाद उत्पादन की वज़ह से हैं। दोनों तटों में *लोलिगो डुआसेली* की विदोहन दर उच्चतम थी। कुछ केंद्रों में *सेपिया अक्युलेटा* और *एस. फरोनिस* का विदोहन इष्टतम स्तर से अधिक था और कुछ अन्य केंद्रों में ये जातियाँ कम विदोहित स्तर पर थी। द्विकपाटियों का अखिल भारतीय उत्पादन 48,792 टन था जो वर्ष 2002 की अपेक्षा 16% अधिक था। मानसूनोत्तर अवधि के अंत और पूर्व मानसून अवधि के दौरान केरल और दक्षिण कर्नाटक तटों के नदीमुखों के उच्च लवण क्षेत्रों में हरित शंबुओं का आविर्भाव इस वर्द्धित उत्पादन का कारण बन गया।

एकोपाथ (ECOPATH) उपयुक्त करके निर्मित कर्नाटक तट के अरब सागर का पोषी नमूना यह व्यक्त करता है कि आवास तंत्र की दक्षता संपूर्ण परिपक्वता प्राप्त करने में है। कर्नाटक तट की मात्स्यिकी के लिए एकोसिम (ECOSIM) उपयुक्त करके किया गया प्रयास यह दिखाता है कि वर्द्धित प्रयास द्वारा बडे नितलस्थ मांसाहारी (मुख्यतः *प्रिस्टिपोमोइडस फिलमेन्टोसस* और रोक कोड्स) मछलियों की प्राप्ति बढ़ायी जा सकती है।

संस्थान ने एन ए टी पी के आइ एन ए आर आइ एस कार्यक्रम के अंदर मात्स्यिकी सांख्यिकी डाटाबेस (उत्पादन सांख्यिकी और निर्यात) का नवीकरण किया है। विश्व मछली केंद्र, पेनांग, मलेशिया द्वारा निधिबद्ध एक परियोजना द्वारा संस्थान ने भारत की वर्तमान और विकासोन्मुख समुद्री संवर्धन प्रौद्योगिकियों को सारणीबद्ध किया है।

समुद्री संवर्धन

तीन स्पोट डामसेल मछली (*डासिलस ट्राइमाक्युलाटस*) और हिमबग डामसेल *डी. अरुआनस* का प्रग्रहण स्थिति में प्रजनन कराया गया। रिपोर्टाधीन वर्ष में *पेनिअस सेमीसलकेटस* के 2 मिलियन पश्च डिंभकों का समुद्र रैंचन किया गया। कालिकट अनुसंधान केंद्र में अत्यधिक मूल्यवाले अलंकारी चिंगट *स्टीनोपस हिस्पिडस* के प्रजनन और स्फुटनशाला उत्पादन में सफलता पायी गयी। चेन्नै के कोवलम क्षेत्र प्रयोगशाला में सिल्लारिड महाचिंगटों की दो जातियों जैसे *थीनस ओरिएन्टालिस* और *सिल्लारस रुगोसस* के प्रजनन और स्फुटनशाला उत्पादन में प्राप्त सफलता एक उल्लेखनीय अनुसंधान कार्य है। *टी. ओरिएन्टालिस* और *एस. रुगोसस* के डिंभक चक्र क्रमशः 26 दिनों और 32 दिनों में पूरा किया गया। *टी. ओरिएन्टालिस* में फिल्लोसोमा - I से पश्च डिंभक (निस्तो) तक की अतिजीवितता 22% और निस्तो से किशोर तक 100% थी। जैविक चिंगट बीजों के स्फुटनशाला उत्पादन और *पी. सेमीसल्केटस* के पालन के मानक विकसित किए गए। एम पी ई डी ए द्वारा प्रायोजित परियोजना के अंदर महाचिंगटों के परिरक्षण उपायों में मध्यस्थ व्यक्तियों की भागीदारी जारी की गई।

सी एम एफ आर आइ में विकसित अर्ध स्वचालित शंबू बीजरोपण मशीन का खेत में परीक्षण केरल के कोल्लम, मलप्पुरम और कोषिकोड जिलाओं के किसानों के सहयोग से किया गया। देश के विभिन्न भागों में प्रशिक्षण कार्यक्रम और खेतों में निदर्शन आयोजित करते हुए खाद्ययोग्य द्विकपाटी पालन तेज़ कराने के लिए जागरूकता अभियान चलाए गए। बडे पखवाले स्क्विड *सेपियोट्यूथिस लेसोनियाना* के प्रजनन में पहली सफलता पायी गयी। इसी प्रकार *सेपिया फारोनिस* का पालन भी 5 महीनों में अंड से परिपक्वता स्थिति तक कराया गया।

पिंक्टाडा फ्यूकेटा और एबलोन *हालियोटिस वेरिया* में ऊतक संवर्धन (tissue culture) प्रौद्योगिकी से समुद्री मोती उत्पादन के लिए विकसित प्राथमिक कार्यों की सफलता विश्व में पहली बार की उल्लेखनीय अनुसंधान सफलता है। यह प्रौद्योगिकी मोती उत्पादन करने लायक अन्य मोलस्कों में भी लागू की जा सकती है। इस प्रौद्योगिकी का एकस्व प्राप्त करने के लिए आवेदन प्रस्तुत किया गया है। स्फुटनशाला में उत्पादित *बाबिलोनिया स्पिरेटा* के किशोरों ने 9 महीनों में 30 मि मी लंबाई और 5.3 ग्रा. भार प्राप्त किए और इस वृद्धि की दर 0.06 मि मी/दिन थी।

एन ए टी पी के अंदर किए जानेवाला शंबु पालन कार्यक्रम केरल और महाराष्ट्र के कई गाँववालों के लिए आय जगाने और बदल रोज़गार व्यवस्था की समुद्री संवर्धन प्रौद्योगिकी के रूप में प्रेरणादायक बन गया। जल शुद्धीकरण के लिए सरल और लगातार पानी बहाव का आदिप्रारूप (Prototype) भी विकसित किया गया। मेबे मोती उत्पादन के लिए 10 विभिन्न आकारों के साँचों (moulds) के आधार बिम्बों के उत्पादन के लिए तकनीक का मानकीकरण करके मोती उत्पादन सुधार किया गया।

ग्रासिलेरिया इडुलिस का तट पर पैदावार करके परीक्षणात्मक पालन करने पर 42 दिनों की पालन अवधि में जैव मात्रा में 26% की वृद्धि देखी गई। पश्चिम तट में *कापाफाइकस* का परीक्षणात्मक पालन करने पर 16 ग्रा/दिन की वृद्धि दर देखी गई। *होलोथूरिया स्काब्रा* के अंडजनन तकनीकों का मानकीकरण किया गया।

पर्यावरणीय तथा जैव विविधता पर अध्ययन

वेरावल और टूटिकोरिन के तप्त स्थलों (hotspots) में कोप्पर का स्तर और चेन्नै में नोर्थ चेन्नै तेर्मल पवर स्टेशन के निकट एन्नूर नदीमुख में ज़िंक का स्तर जल जीवों के लिए तय किए गए ई पी ए सुरक्षा स्तर से ज़्यादा था।

पश्चिम तट की अपेक्षा पूर्व तट में कलनोइड अरित्रपादों (copepods) की जैव विविधता उच्चतम थी। अरित्रपादों की दो जातियाँ बंगाल उपसागर के उत्तर-पश्चिम भाग में और चार जातियाँ आन्डमान-निकोबर समुद्र में स्थानिक (endemic) देखी गई। केरल तट के कई स्थानों में घूर्णीकशाभों (dinoflagellates) की फुल्लिकाएं दिखाई पडी और अक्तूबर, 2003 में तंकशेरी में मछलियों तथा कवच मछलियों की मृत्युता रिपोर्ट की गई।

महासागर विकास विभाग द्वारा प्रायोजित परियोजना के अंदर संस्थान ने *ओ आर वी सागर कन्या* में समुद्री खोजयात्रा में भाग लिया और उप अन्टार्टिक समुद्र तक के दक्षिण महासागर के जलराशिकी प्लवकों और समुद्री स्तनियों पर सूचनाएं संग्रहित की। नदी श्रृंखलीकरण (रिवर लिंकिंग) परियोजना के प्रसंग में, पश्चिम तट के समुद्र के पोषक और उत्पादकता रूपरेखा पर परिवर्तित नदी बहाव के प्रभाव निर्धारित करने की परियोजना के अनुसंधान परिणामों का विशेष तात्पर्य है।

जैव प्रौद्योगिकी

भारतीय कृषि अनुसंधान परिषद के महा निदेशक ने ड्यूप्लेक्स पी सी आर किट और पंक कर्कट वज़न बढ़ाव और अलंकार मछलियों के लिए रूपाइत गुटिका खाद्य का विमोचन किया। सी एम एफ आर आइ द्वारा विकसित पी सी आर किट के उत्पादन और विपणन का अधिकार भुगतान व्यवस्था पर एक निजी कंपनी को स्थानांतरित किया गया।

सोयाबीन आटा और तेल खली के मिश्रण से उत्पादित किण्वित उत्पाद (fermented product) चिंगट खाद्य में मछली आहार के प्रति भागिक प्रतिपूरक के रूप में सफल रूप से उपयुक्त किया गया। परीक्षण किए गए कुल 15 जीवाणुज वियुक्तों (bacterial isolates) में से दो विभेदों ने रोगजनकता के प्रति विरोध दिखाया और रोग प्रबंधन में गट प्रोबयोटिक के रूप में इनका शक्य प्रयोग साबित हुआ भी है। हरित शंबु *पेर्ना विरिडिस* के क्रिस्टली रूपी होमोजनेट से लाइसोसोम का शोधन किया गया। गरान अनूप (mangrove swamp) से फाइटेस का उत्पादन करने वाले *बासिलस* विभेद का विलगन किया गया और इसका भागिक शोधन भी किया गया।

डी एन ए आधारित बहुरूपता अध्ययन से यह दिखाया पडा कि पारादीप से प्राप्त *नेमीप्टीरस जापोनिकस* के मछली स्टॉक कोच्ची और चेन्नै के स्टॉक से थोडा समानता रखनेवाले थे। *एन. मीसोप्रियोन* में स्टॉक समांगता विद्यमान थी। समुद्री अलंकार मछली *आम्फीप्रियोन* की चार जातियों में जातिवृत्तीय संबंधत्व (phylogenetic relationship) का निरूपण किया गया और फालतू बनाई गई *ए. सीबे* में तथाकल्पित लिंग विशिष्ट अंकक (putative sex-specific markers) विकसित किए गए।

विस्तार और अर्थविज्ञान

विभिन्न मछली पकड केंद्रों में विभिन्न मछली जातियों के मूल्य वितरण और मूल्य में होनेवाले माहिक उतार-चढ़ाव और थोक बिक्री और फुटकर बिक्री पर अध्ययन किया गया। सुरा, सुरमई और पेनिआइड झींगा जैसी जातियों की बिक्री में मछुआरों ने उपभोक्ता के रुपए का 70% कमाया है। एक दिवसीय मत्स्यन के लिए आंध्रा प्रदेश (0.41) और केरल (0.62) में कम परिचालन अनुपात देखा गया। सकल आय पर श्रम और ईंधन लागत का सकारात्मक प्रभाव पडा है। आइ वी एल पी के अंदर एरणाकुलम जिला के वाइपीन द्वीप के एलमकुन्नपुष्पा गाँव में मात्स्यिकी (4), पशुधन (3) और कृषि (6) में कुल 13 प्रकार के कार्यक्रमों के कार्यान्वयन में मध्यस्थता की।

ए टी आइ सी ने वर्ष 2003 के दौरान रोगनिदान सेवा, प्रयोगशाला परीक्षण, गुणवर्धित मात्स्यिकी उत्पादों के विपणन, प्रकाशनों और अन्य प्रौद्योगिकीय निवेशों द्वारा लगभग एक लाख रुपए का आय जगाया है। संस्थान द्वारा निर्मित एनिमेशन फिल्म *छोटी मछलियाँ और लघु जाल* का टोकियो में आयोजित प्रसिद्ध ग्लोबल एनवयोर्नमेन्ट फिल्म फेस्टिवेल-2003 के पुरस्कार के लिए चुना गया है।

प्रकाशन, नई परियोजनाएं और मान्यताएं

संस्थान के कार्मिकों के 45 अनुसंधान लेख प्रमुख चर्चित पत्रिकाओं में प्रकाशित हुए और 119 तकनीकी लेख और 57 कागज़ात विभिन्न संगोष्ठियों/ परिचर्चाओं में प्रस्तुत किए गए। सी एम एफ आर आइ ने भारतीय कृषि अनुसंधान परिषद में उत्तम हिंदी कार्यान्वयन के लिए *राजर्षि टंडन पुरस्कार* (II स्थान) हासिल किया। वर्ष 2003 के दौरान हिंदी के विभिन्न योग्यता कार्यक्रम भी चलाए गए। नील कर्कट के ब्रूड स्टॉक विकास के लिए तीन नई परियोजनाओं, खाद्यशुक्ति पालन की प्रौद्योगिकी के उन्नयन और आनाय मत्स्यन के आर्थिक मूल्यांकन के कार्यान्वयन के लिए भा कृ अनु प की तदर्थ योजना में अनुमोदन प्राप्त हो चुका है।

प्रशिक्षण एवं शिक्षा

शिक्षा कार्यक्रम के अंदर वर्ष 2003 में 14 नियमित छात्रों और संस्थान की प्रायोजित परियोजनाओं के अध्येताओं को पी एच. डी. उपाधि प्रदान की गई। एक एम.एफ.एससी छात्र को उत्कृष्ट शोध-प्रबंध के लिए *डॉ एन.आर. मेनोन पुरस्कार* प्राप्त हुआ। दो छात्र ट्रिवान्ड्रम में आयोजित अंतर कालेजियट प्रश्नोत्तरी जीत हुए। रिपोर्टाधीन वर्ष में कृषि विज्ञान केंद्र ने 24 प्रशिक्षण कार्यक्रम और 82 पाठ्यक्रम आयोजित किए। संस्थान के कार्मिकों को नेतृत्व कुशलता, आपसी सहयोग और सामूहिक सांस्कृतिक सदाचार कार्यबोध बढ़ाने के लिए मानव संसाधन विकास का प्रशिक्षण दिया गया।

Acronyms Used

ADAK	Association for Development of Aquaculture in Kerala
ATIC	Agricultural Technology Information Centre
BFFDA	Brackishwater Fish Farmers Development Agency
CARI	Central Agricultural Research Institute
CGP	Competitive Grants Programme
CIBA	Central Institute of Brackishwater Aquaculture
CIFA	Central Institute of Freshwater Aquaculture
CIFE	Central Institute of Fisheries Education
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
CoF	College of Fisheries, Mangalore
DBT	Department of Bio-Technology
DOD	Department of Ocean Development
DST	Department of Science & Technology
E	Exploitation Rate
FAO	Food and Agricultural Organisation
FSI	Fishery Survey of India
GAU	Gujarat Agricultural University
GOPL	GMR PSEG Operations Private Limited, Mangalore
IASRI	Indian Agricultural Statistics Research Institute
ICAR	Indian Council of Agricultural Research
IFS	International Foundation of Science
IGIDR	Indira Gandhi Institute of Development Research
IOTC	Indian Ocean Tuna Commission
ISD	Information System Development
IVLP	Institution Village Linkage Programme
KIOCL	Kudremukh Iron Ore Company Limited
KKV	Konkan Krishi Vidhyapeeth
MM	Mission Mode
MOE&F / MEF	Ministry of Environment & Forest
MPEDA	Marine Products Export Development Authority
MRPL	Mangalore Refineries and Petrochemicals Limited
MSY	Maximum Sustainable Yield
NAARM	National Academy of Agricultural Research Management
NABARD	National Bank for Agricultural and Rural Development
NATP	National Agricultural Technology Project
NBFGR	National Bureau of Fish Genetic Resources
NGOs	Non-Governmental Organisations
NIO	National Institute of Oceanography
PSR	Production Systems Research
RC	Research Centre
RGCA	Rajiv Gandhi Centre for Aquaculture
SEAFDEC	South East Asian Fisheries Development Centre
SFDs	State Fisheries Departments
TANUVAS	Tamil Nadu Veterinary and Animal Science University
WFC	World Fish Centre
Z	Mortality Rate

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